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RESULTS OF TESTS USING A 0.03 SCALE MODEL (47-OTS) OF THE SPACE SHUTTLE INTEGRATED VEHICLE IN THE AEDC 16 FOOT TRANSONIC PROPULSION WIND TUNNEL (IA105A)

by

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Prepared under NASA Contract Number NAS9-16283

by

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Houston, Texas

WIND TUNNEL TEST SPECIFICS:

Test Number:	P41T-P1, TF470
NASA Series Number:	IA105A
Model Number:	47-OTS
Test Dates:	Sept. 8 thru 27, 1977 and Nov. 12 thru 20, 1977
Occupancy Hours:	281

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ABSTRACT

An experimental investigation (test IA105A) was conducted in the Arnold Engineering Development Center 16-foot Transonic Propulsion Wind Tunnel from September 8, 1977 through September 27, 1977 (first entry) and from November 12, 1977 through November 20, 1977 (second entry).

The objective of these tests was to obtain aerodynamic loads on all vehicle elements (orbiter, external tank and solid rocket boosters) by pressure integration and to measure loads directly by load indicators on the wing and vertical tail and elevon hinge moments.

Data were obtained in the Mach number range from 0.6 to 1.55 with Reynolds numbers per foot of 2.5×10^6 to 4.0×10^6. The test was conducted using angle of attack sweeps at fixed sideslip angles during the first entry and sideslip sweeps at constant angle of attack during the second entry.

Angles of attack and sideslip were both within a range consistent with the trajectory dispersions with the maximum angle being dependent upon the requirements at a particular Mach number.

ABSTRACT (Concluded)

Configuration variations consisted of a series of differential inboard/outboard elevon angle settings at zero aileron angle, with and without the Shuttle Infrared Leeside Temperature Sensor (SILTS) pod on the orbiter vertical tail.

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INTRODUCTION

Test IA105A was conducted in the Arnold Engineering Development Center 16 foot Transonic Propulsion Wind Tunnel. The test was conducted in two segments during the test periods from September 8 through September 27, 1977 (first entry) and from November 12 through November 20, 1977 (second entry). Total tunnel occupancy hours for the two test periods were 281 hours. The test article was a 3% replica (Model 47-OTS) of the Space Shuttle Launch Vehicle, Configuration 6, as shown in figure 2.

Pressure and force data were obtained at Mach numbers from 0.6 to 1.55 for angles of attack and sideslip within a $\pm 8^{\circ}$ matrix. A six-component balance was used to determine orbiter force and moment data in the presence of the external tank and solid rocket boosters. Forces and moments on the wing, vertical tail and elevons were measured using appropriate strain gage balances. The model was instrumented with 1586 pressure taps distributed over the orbiter, external tank and the left solid rocket booster to measure pressure distributions over the launch vehicle elements, localized loads on various protuberances on the external tank (ET) and solid rocket booster (SRB) (see figures 4 through 9 and Tables VI through X).

A secondary objective of this test was to determine the effect of the Shuttle Infrared Leeside Temperature Sensor (SILTS) on the pressure distributions on the vertical tail. The pod was mounted at the tip of the vertical tail and was not instrumented.

INTRODUCTION (Concluded)

This test was conducted in conjunction with the following other tests:

IA105B (DMS-DR-2413) and IA184 (DMS-DR-2456) conducted at the NASA/Ames Research Center 9 x 7 foot supersonic wind tunnel to extend the Mach range up to 2.50 using the same 3% model (47-OTS).

IA156A (DMS-DR-2403) and IA156B (DMS-DR-2408) conducted using a 2% model (89-OTS) in the AEDC 16T and the NASA/Ames 9 x 7, respectively, to determine individual component loads and attach structure loads.

IA182 (DMS-DR-2439) and IA183 (DMS-DR-2444) conducted in the AEDC 16T using the 3% and 2% models, respectively, to investigate flow and angularity corrections to apply to the IA105A and IA156A data.

This report provides documentation of test IA105A consisting of remarks on the conduct of the test, descriptions of the model and test procedure, information on data reduction and plotted and tabulated test conditions and results.

NOMENCLATURE

SYMBOL	MNEMONIC	DEFINITION
	AADS	Ascent Air Data System.
A_i		Area over which P_i acts, ft^2.
	AEDC	Arnold Engineering Development Center
AFA	AFA	flow angularity in the tunnel pitch plane, positive up, degrees
α, α_X	ALPHA(X)	component angle-of-attack, where X → 0 = orbiter, T = external tank, S = SRB
	ALFC	model angle-of-attack corrected for sting imbalance deflections
ALFAOU	ALFAOU	orbiter angle-of-attack (uncorrected for flow angularity), degrees
ALFASU	ALFASU	SRB angle-of-attack (uncorrected for flow angularity), degrees
ALFETU	ALFETU	external tank angle-of-attack (uncorrected for flow angularity), degrees
ALPHAI	ALPHAI	tunnel instrumentation indicated pitch attitude, degrees
β, β_X	BETA(X)	component angle-of-sideslip where X → 0 = orbiter, T = external tank, S = SRB.
BETETU	BETETU	external tank sideslip angle (uncorrected for flow angularity), degrees
BETAOU	BETAOU	orbiter sideslip angle (uncorrected for flow angularity), degrees

SYMBOL	MNEMONIC	DEFINITION
BETASU	BETASU	SRB sideslip (uncorrected for flow angularity), degrees
BFA	BFA	flow angularity in the tunnel cross flow plane, positive from right to left looking upstream, degrees
B_{vt}		vertical tail bending moment, in-lbs.
B_W		wing bending moment, in-lbs.
C_A	CA	axial force coefficient
C_{A_b}	CAB	orbiter base axial force coefficient
$C_{AB_{V_t}}$	CABVT	vertical tail base axial force coefficient
C_{A_f}	CAF	orbiter forebody axial force coefficient
C_{A_u}	CAU	orbiter axial force coefficient, uncorrected
C_{A_v}	CAV	vertical tail axial force coefficient
C_{B_v}	CBV	vertical tail bending moment coefficient
C_{BW}	CBW	wing bending moment coefficient
$C_{h_{ei}}$	CHEI	inner elevon hinge moment coefficient, about hinge line X = 1387.0
$C_{h_{eo}}$	CHEO	outer elevon hinge moment coefficient, about hinge line X = 1387.0
$\mathcal{C}_L$	CL	centerline
C_ℓ	CBL	orbiter rolling moment coefficient, body axis system
C_m	CLM	pitching moment coefficient

SYMBOL	MNEMONIC	DEFINITION
C_{m_B}	CLMB	orbiter base pitching moment coefficient
C_{m_f}	CLMF	orbiter forebody pitching moment coefficient
C_{m_u}	CLMU	orbiter pitching moment coefficient, uncorrected
C_{m_v}	CMV	vertical tail pitching moment coefficient
C_N	CN	normal force coefficient
C_n	CYN	orbiter yawing moment coefficient
C_{N_B}	CNB	orbiter base normal force coefficient
C_{N_f}	CNF	orbiter forebody normal force coefficient
C_{N_u}	CNU	orbiter normal force coefficient, uncorrected
C_{n_v}	CTV	vertical tail yawing moment coefficient, using vertical tail reference
C_{N_W}	CNW	wing normal force (shear) coefficient
	CNSTNG	normal force coefficient of the sting (used for sting deflection calculations only)
C_{p_i}	CP(i)	surface tap pressure coefficient, port i
C_{T_W}	CTW	wing torsional coefficient
C_{T_v}	CTV	vertical tail torsional coefficient
C_{S_v}	SCF	vertical tail shear force coefficient
C_Y	CY	orbiter side force coefficient
C_{Z_v}	CZV	vertical tail normal force coefficient
DEINR	DEINR	inboard elevon deflection (no load), degrees

SYMBOL	MNEMONIC	DEFINITION
DEONR	DEONR	outboard elevon deflection (no load), degrees
Δ		Incremental
ET	ET	External Tank
He_i	HEI	inboard elevon hinge moment, in-lbs.
He_o	HEO	outboard elevon hinge moment, in-lbs.
HL	HL	Hingeline
δe_i	IB-ELV	inboard elevon deflection angle, degrees
	I.D.	inside diameter
LH_2	LH2	liquid hydrogen
LO_2	LO2	liquid oxygen
M	MACH	Mach number
MRC	MRC	moment reference center
δe_o	OB-ELV	outboard elevon deflection angle, degrees
N_{vt}	NVT	vertical tail normal (shear) force, lbs.
N_w	NW	wing normal (shear) force, lbs
OMS	OMS	orbital maneuvering system
OTS	OTS	integrated vehicle (orbiter, external tank, SRB)
OV	OV	orbiter vehicle
	O.D.	outside diameter
PHII	PHII	tunnel instrumentation indicated roll attitude, degrees

NOMENCLATURE (Continued)

SYMBOL	MNEMONIC	DEFINITION
ϕ	PHI	angular cylindrical coordinate position around body, degrees
P_i		pressure at surface tap i, psf
P_o	P	freestream static pressure, psf
P_t	PT	freestream total pressure, psf
q	Q(PSF)	freestream dynamic pressure, psf
	RN/L	unit Reynolds number, million per ft.
SRB	SRB	Solid Rocket Booster
	SSME	Space Shuttle Main Engine
	SILTS	Shuttle Infrared Leeside Temperature Sensor
	SOFI	Spray on foam insulation
T_t, T_o	TTF	freestream total temperature, ^oF
T_{vt}	TVT	vertical tail torsion moment, in-lbs
T_w	TW	wing torsion moment, in-lbs
X_T	XT	body station on the external tank
X_{CP_v}	XCPV	vertical tail center-of-pressure, longitudinal location, in.
X_{CP_w}	XCPW	wing center-of-pressure, longitudinal location, in.
X_o/LB	X/LB	longitudinal location on orbiter body surface, fraction of body length
X/C_{BF}	X/CBF	chordwise location on body flap, fraction of local chord

NOMENCLATURE (Continued)

SYMBOL	MNEMONIC	DEFINITION
X_T/L_T	XT/LT	longitudinal location on external tank body surface, fraction of body length
X_V/C_V	XV/CV	chordwise location on vertical tail, fraction of local chord
X_S/L_S	XS/LS	longitudinal location on solid rocket booster surface, fraction of body length
X_W/C_W	XW/CW	chordwise location on wing surface, fraction of local chord
Y_o	YO	orbiter base lateral centerline
η_W	Y/BW	spanwise location on wing, fraction of semi-span
η_{BF}	Y/BBF	spanwise location on body flap, fraction of body flap span
Y_{CPV}	YCPV	vertical tail center-of-pressure, lateral location, in.
Y_{CPW}	YCPW	wing center-of-pressure, lateral location, in.
Z_o	ZO	orbiter water line
η_V	ZV/BV	spanwise location on vertical tail, fraction of vertical tail span
Z_{CPV}	ZCPV	vertical tail spanwise location of the center-of-pressure, in.
Z		distance from tunnel floor to sting centerline, in.

SUBSCRIPTS

B, b	base
f	forebody
l, L	left, local
O	orbiter

SUBSCRIPTS

R,r	right
S	SRB
T	External Tank
t	total
u	uncorrected
V, V_t	Vertical Tail
w	wing
∞	freestream

REMARKS

Test IA105 was conducted in a manner which varied considerably from the original plan as described in the pretest report (Reference 1). The test was conducted in two separate tunnel entries with an orbiter balance and model support system change for the second entry. The pretest report was not updated to account for these changes.

Many anomalies occurred in the data during the test. In general, data not considered reliable were deleted from the final data. Three exceptions to this are as follows.

a) The pressure and force data, prior to part number 147, was subject to the flexibility of the orbiter balance and the subsequent misorientation of the orbiter relative to the external tank. Orbiter balance data were deleted for these runs due to balance fouling but the pressure data are presented. The basic runs were repeated during the second entry.

b) At various times throughout the test, relatively large zero shifts occurred in the data from the wing, elevon and vertical tail balances. These data are calculated using the initial zeros only.

c) Two problems existed with the operation of the pneumatic multiplexers (Scanivalves®). The most significant of these consisted of bad calibrate and/or second zero readings. Where the calibrate level varied considerably from the average of the other transducers the average was used. (The second zero was not used in any calculations.) This correction, in most cases may be considered adequate, however several possibilities exist that would make all or part of the data from the valve showing the bad calibration invalid:

1) If both the calibrate (Port 1) and the second zero reading (Port 24) are in error, a phasing problem is indicated. In extreme cases this will result in leakage between adjacent valve ports.
2) In less extreme cases phasing problems may result in large lag times.
3) If the initial zero reading is in error due to leakage to adjacent ports all pressures measured on that valve will be affected as it is used in the calculations. There is no way of determining if this reading was in error.

The second problem concerned non-syncronous stepping of the scanivalve drives. On occasion the valves would not all home together. When this was observed the data was repeated but there is no way of checking if it occurred at other times. This problem is, however, very rare.

REMARKS (Concluded)

Pressure data known to have been bad are delineated in Table V.

CONFIGURATIONS INVESTIGATED

The model was a 0.03-scale replica of the Rockwell International Space Shuttle Vehicle in launch configuration. The launch configuration consists of the assembly of a payload carrying orbiter, an expendable external oxygen/hydrogen tank (ET) (which provides fuel for the orbiter main engines), and two recoverable solid rocket boosters (SRB's). The general layout of the model is shown in Figure 2a.

The orbiter is of blended wing body design with a double delta planform ($81^\circ/45^\circ$ leading edge) 12% thick wing with full span elevons incorporating a six-inch interpanel gap between the independently deflectable inboard and outboard panels. A single swept (45° leading edge) vertical tail with rudder and/or speed brake capability is mounted between two orbital maneuvering system (OMS) pods. A single body flap is fitted on the lower trailing edge of the fuselage.

The orbiter fuselage is in accord with Rockwell International control drawing VL70-000140A, with the vertical tail as defined by drawing VL70-000146A. The OMS pods are of the later VL70-000140C configuration, these being a combination of the VL70-08401 and VL70-08410 drawings. Fitted to this is a new orbiter vehicle 102 wing as defined in the MD-V70 data book(s). For the purposes of this test and report, this combination shall be referred to as a "102 orbiter". The orbiter is shown in Figure 2b.

The ET is of cylindrical cross section with a nominal diameter of 333.0 inches full-scale and a maximum diameter of 336.2 inches full-scale. The forward portion of the ET has a tangent ogive nose which terminates in a biconic nose cap over the LOX vent valve. The biconic nose has a pitot and four static pressure taps as a sensing part of the ascent air data system (AADS). Only two of the four static taps were simulated. The forward third of the tank is filled with LOX, and the aft two thirds is a vessel for liquid hydrogen. The aft end of the tank is basically an ellipsoid of revolution. Between the two vessels is a structure of stiffeners which is slightly larger than the nominal tank diameter. Covering the entire tank is a spray-on foam insulation (SOFI) of varying thickness as dictated by the relative heat load, i.e., approximately 2.5 inches thick on the tangent ogive, 1.0 inch thick on the cylindrical portion of the tank and 2.0 inch thick on the rear ellipsoid. The diameters given above include this SOFI. External to the ET surface are a number of protuberances which fall into three major categories: electrical trays, fluid lines, and attach hardware. Electrical trays which run parallel to the centerline of the tank are simulated, those which run up next to the aft orbiter/ET attach hardware are not. Fluid lines modeled are the LOX and LH_2 feed and vent plumbing. The attach hardware that is considered as part of the tank is the front and rear ET/orbiter attach structure, which is discarded with the ET at the end of the main engine burn.

The external tank is built to the geometry described above and more specifically to Rockwell International Interface Control Drawing ICD 2-00001, Rev. C, plus Interface Revision Notices B and C. The external tank is shown in Figure 2c.

The two solid rocket boosters (SRB's) are 146-inch nominal diameter cylinders, each with an 18-degree semi-angle nose with a 13.27-inch spherical tip. An 18-degree flared skirt, 208.20-inch diameter, protects the gimbaled rocket nozzle. A flexible, donut-shaped seal and thermal shield is provided between skirt and nozzle. Major protrusions from the basic envelope include a forward attach lug, separation thrusters front and rear, aft attach ring, various stiffeners and a full length electrical systems tunnel.

In common with the external tank, the SRB is built in accord with the Rockwell International Interface Control Document ICD 2-00001C, with the supplement of Interface Revision Notices B and C. An SRB is shown in Figure 2d.

The entire model was therefore basically in accord with the Configuration 6 Launch Vehicle, comprised of the 102 orbiter and T_{39} tank and S_{27} booster.

The orbiter provided for this test series is constructed utilizing existing orbiter fuselage, vertical tail, OMS pods, new wing, and body flap components. An internal beam/bridge/balance block has been constructed to allow mounting the orbiter from the attach hardware of the ET and to measure six component airloads on the orbiter. Safety factors of three (3) on yield and five (5) on ultimate have been observed. The complete orbiter weighs approximately 140 pounds. The model has been principally fabricated of 17-4 stainless steel and aluminum alloy with some contouring with Renite. The orbiter is fabricated around a balance block of 17-4, bored and sleeved to accept the Task 2.5-inch MK XXII balance. This block is located in the rear half of the fuselage and the 7076 aluminum pieces which form the outer mold line of the fuselage are bolted to it. These pieces consist of a fuselage cover, two fuselage fairings and two wing fairings at the rear of the body, two side covers, and a forward nose and top cover. The two OMS pods are fabricated of 7076-T6 aluminum alloy. The OMS nozzles are simulated in aluminum as are the RCS thrusters. The fuselage and OMS pods are heavily pressure instrumented.

The wing is a two piece aluminum article screwed to a central steel wing beam. This beam of cross shaped planform supports one wing on a tang on each side of the central plate. The right hand tang is instrumented with strain gauges to form the three component wing load indicator balance. While the center of this beam forms the outer mold line of the bottom of the orbiter, the tangs are out of the airstream. The wings are made integral with the glove and a labyrinth seal is provided on the metric side to improve the data quality. The wings are extensively hollowed to reduce the model weight. The left hand wing is instrumented with pressure taps. Each of the wings is fitted with deflectable inboard and outboard elevons which are supported in torsion only by a beam mounted on the hinge line, and in all other degrees of freedom by plain bearing hinges, also on the scale hinge line. Identical R.H. and L.H. elevon supports insure similar aeroelastic deflections. The opposite end of the elevon support beam is fitted with a ball bearing to minimize hysteresis effects. The right hand wing panels are supported on beams which are strain gauged. Available nominal deflections and actual unloaded measured deflections are listed in Table III. Simulated flipper doors are fitted to the upper wing surface.

An aluminum body flap with hinge moment capability and 40 pressure taps is provided. The hinge moment capability was not used, nor was the body flap deflection changed during this test entry.

Two vertical tails are provided for this test, the first being of 17-4PH Armco with a single plain hinged rudder/speed brake on each side. This is a pressure instrumented surface with 76 pressures (including one of the base group, #301). The hardline tubulations terminate at the front of the base of the tail, from whence the tubes are of flexible plastic to the Scanivalves. The tail itself is hard mounted to the balance block. The second vertical is of aluminum and mounts through this same cavity, but is supported on a six component balance to measure vertical tail airloads directly. No rudder or speed brake deflections were used for this test.

Simulated SSME nozzles are provided in the base of the orbiter, since no sting interferes. The nozzles are set at the nominal angles of 16 degrees up, no yaw upper, and 10 degrees up, ±3 1/2 degrees yaw outboard for the lower two. The material used is aluminum alloy. The nozzles are mounted to a base plate which closes off the balance cavity at the back of the orbiter.

The entire orbiter is mounted on the 6 component balance, with the taper fitting into a block in the cavity at the rear of the fuselage. This block is screwed to a beam running under the balance block and also to a stiffener rod that runs forward above the right corner of the balance block to a "flying wedge" piece attached to the right front of the longitudinal beam. The ET attach hardware mounts to the bottom beam through holes in the bottom of the orbiter.

The external tank is principally fabricated of aluminum alloy to reduce weight and fabrication costs. The approximate weight of the external tank with instrumentation is 190 pounds. Safety factors of three (3) on yield and five (5) on ultimate have been observed in the design and construction of the tank.

The 333-inch full-scale diameter tank is built up out of five principal shell-like pieces that conform to the outer mold line of the tank including the spray on foam insulation. These pieces are a biconic forward tip which includes the entire tangent ogive (and is actually made up of two non-separable pieces because of a late lines change), a cylindrical mid-body, a short cylindrical aft body, and an aft cap. Slipped around the back of the aft body to fair into the cap is a ring designated a recontouring block, and an .030-inch shim is placed beneath the cap. These last two items are also the result of a late lines change. There are two holes aft and one hole forward on each side which are spotfaced inside and out to accept the SRB ring mounting studs and screws.

Slipped into the front of the nose of the tank is a biconic vent valve housing with an integral 10-degree half-angle conical yaw probe at the front. This yaw probe (The Ascent Air Data System or AADS) is instrumented to scale with two .010-inch OD hypodermic tubing taps at the scale location, .075-inch aft of the tip of the spike (taps 1901 and 1902).

The orbiter/ET attach hardware is scaled to as great a degree as possible and is load bearing. The orbiter/ET front attach was originally fabricated from a single piece of 17-4 stainless steel with two end plates, but prior to testing was modified to prevent orbiter rolling moment from being transmitted to the structure by use of a pin joint at the orbiter.

The lower end plate fits into a milled recess in the ET mid-body; the upper one fitting into an analogous recess in the orbiter, and fastened to the orbiter balance beam.

The aft load is carried through the vertical runs of the LO_2 and LH_2 feed lines, which are bushed, hollow bolts securing the ET to the orbiter balance block. The simulated aft ET/SRB attach hardware does not carry load.

Detailed external tank protuberances are provided. The pressure and feed lines are as previously used on model 47-T on the 331-inch tank, the ellipsoid fairings and cable trays are new construction.

Scanivalve and balance cables and pressures are routed into the tank from the orbiter through the hollow rear attach bolts. These and the cables from the tank Scanivalves are led out to the SRB's just behind the SRB front attach. The entire tank and its protrusions are pressure instrumented.

The two aluminum SRB's are reworked from a previous usage with the principal alterations being to the protuberances, the number of pressure taps (added to reflect the requests of the customer), and the mode of attaching the SRB to the ET. The SRB to ET attachments were modified to bear the expected loads and to carry the electrical leads through from the tank.

The SRB's are fabricated of 2024-T4 aluminum alloy to reduce weight. The weight of the right hand SRB is approximately 40 pounds and the weight of the thinner, left hand SRB with the Scanivalves is approximately 21 pounds. Safety factors of three (3) for yield and five (5) for ultimate have been observed in this design.

Both SRB's are built around a 2.00-inch I.D. x 3.38-inch O.D. aluminum sleeve. This sleeve is pinned to the eccentric adapter and to the body of the SRB with pull pins on each side. The SRB itself consists of four main parts, a nose cone, a forebody, an aft attach ring and an aft body and nozzle assembly.

The SRB's are built up around the forebody with all instrumentation installed and are then slipped into the mounting holes in the tank. The aft body, spacer skirt, nozzle and thermal protecting shield of 2024 aluminum alloy are assembled as a unit on the forebody, sandwiching the aft attach ring between them. This ring is carved of a single piece of stock with integral mounting studs that simulate the aft attach struts.

A 7/16 AHCS passes through the simulated SRB/ET front attach to secure the front of the SRB to the ET. The nose cone slips over the forebody of the SRB after the booster is secured to the external tank.

Nozzle actuator struts are simulated on each of the SRB aft skirts. The SRB aft separation thrusters and skirt stiffeners are also attached to the skirt. The cable tunnel is simulated on both SRB's. The SRB stiffener rings are split to fit over the skirt and snap into a locating groove.

The left hand SRB is instrumented with pressure taps and a multiple Scanivalve unit. To provide access to the valves, a cover is fit to the LH forebody. All reference pressures, and instrumentation leads from the SRB are run internal to the LH fork of the sting.

The following nomenclature, illustrated in Figures 2b through 2d, was used to designate the model components:

Symbol	Description
B_{62}	-140 A/B Body
C_9	-140 A/B Canopy
E_{64}	OV 102 Elevon
W_{131}	OV 102 Wing
M_{16}	Short OMS pods, -140 C w/nozzles
N_{28}	OMS Nozzles
N_{112}	SSME nozzles, OV102 complete
R_5	146 A Rudder
V_8	146 A Vertical Tail
FD_3	Flipper Doors
F_9	Body Flap

CONFIGURATIONS INVESTIGATED (Concluded)

Symbol	Description
A configuration code has not been assigned for the SILTS pod.	
T_{39}	External Tank complete 330-inch O.D. with protuberances
S_{27}	Solid Rocket Booster complete 146-inch O.D. with protuberances

TEST FACILITY DESCRIPTION

The AEDC PWT 16-Ft. Transonic Tunnel (Propulsion Wind Tunnel, Transonic 16T) is a continuous-flow closed-circuit tunnel capable of operation within a Mach number range of 0.20 to 1.60. The tunnel can be operated within a stagnation pressure range of 120 to 4000 psfa depending upon the Mach number. The stagnation temperature can be varied from an average minimum of about 80 to a maximum of 160°F as a function of cooling water temperature. Using a special cooling system of mineral spirits, liquid nitrogen, and liquid air, the stagnation temperature range can be varied from +30 to -30°F. Supersonic velocities are obtained by use of flexible-wall, Laval type nozzles.

The test section is 16-ft. square (in cross section) and 40-ft. long. The entire test section and supporting structure is constructed as a separate unit, called the test section cart, and is removable from the tunnel circuit. The test section carts may be moved to the model installation building where the test article and associated equipment are installed.

Two 40-ft. long test section carts are available for testing throughout the design temperature range. These carts are each 20-ft. long and are used in pairs to form the 40-ft. long test section. Each cart may be used in either the forward or aft position in the test section.

The test section is completely enclosed in a plenum chamber which can be evacuated, allowing part of the tunnel main flow to be removed through the test section perforated walls, thereby unchoking the test section at near sonic speeds and alleviating wall interference effects.

The 16T standard sting support system was used to support and position the 0.03-scale model in the test section during the first test entry. The model was supported by a dual sting arrangement consisting of two, 2.0-in. diam. stings exiting from the bases of the left and right hand solid rocket boosters (SRB). These stings were then attached by adapters to 4.16-in. diam. parallel stings which were mounted into the sting support system. This support arrangement allowed the base of the orbiter to be essentially free from any support system interference.

The sting support system utilizes computer control to position the model at angles of attack and sideslip by means of combinations of pitch and roll angles. This model support system is advantageous in that the model can be maintained at, or close to, the tunnel centerline where flow angularity is a minimum. It has the disadvantage, however, of relatively slow pitch and roll rates (0.17 deg/sec and 1.25 deg/sec, respectively) that proved to be too slow to meet the data acquisition requirements in the time available. A sketch showing the location of the 0.03-scale model in the test section is presented in Fig. 10a and a photograph showing this installation is presented in Fig. 11a.

The Hi-Pitch model support system was utilized for the subsequent test reentry. This support system has the capability of pitch rates up to 8 deg/sec and roll rates exceeding 20 deg/sec. For these test entries, a pitch rate of approximately 1 deg/sec and a roll rate of 20 deg/sec was selected. Sketches and photographs showing the 0.03-scale model supported on the Hi-Pitch system are shown in Figs. 10b and 11b.

The Hi-Pitch support system was mounted into a dummy roll mechanism of the standard sting support system and utilized the vertical traverse feature of the latter system to maintain the model as close to tunnel centerline as possible within the physical constants of ±36 in. vertical traverse of the standard sting support system. The resulting position for the orbiter was approximately on centerline at angles of attack of 0° or greater and 2 feet below tunnel centerline at a sting pitch angle of -10 deg. Model angles of attack and sideslip were established by computer control utilizing the hydraulic motors of the Hi-Pitch system to position the sting at appropriate pitch and roll angles.

TEST PROCEDURE AND INSTRUMENTATION

The model was instrumented so that pressure and force data could be obtained simultaneously, except on the vertical tail where both pressure instrumented and force (strain gauge) instrumented vertical tails were used.

The model was heavily instrumented to measure surface pressures. A total of 1586 pressures were measured by thirty-eight 48-port pneumatic commutators (Scanivalves®) located in the model components as shown in Fig. 3. The location of the 1586 pressures are shown in Figs. 4 through 9 and are categorized as follows:

Major Model Component	Model Component		No. of Orifices
Orbiter	Fuselage		206
	Flap		40
	Base		24
	Vertical Stabilizer		75
	Wing		283
		Total	628
External Tank	Body		424
	Base		74
	Protuberances		232
	AADS		2
		Total	732
Solid Rocket Boosters	Body		175
	Base		10
	Protuberances		41
		Total	226

Not all pressures were measured during every run. The Scanivalves® were tubed to allow for abbreviated scans in the interest of reducing test time. The second entry tubing scheme differed from the first entry to allow for even shorter scan where only base pressures were measured. In general forebody pressures were not measured after the first complete Mach number sweep as those pressures were not affected by elevon deflection changes.

In addition to the model pressures, forces and moments were measured by strain gauge balances as follows:

Balance Location	Type	Model Forces & Moments Measured or Calculated
Orbiter	6-component	Orbiter normal force, side force, axial force, pitching-moment, rolling moment, yawing moment
Wing	3-component	Wing normal force, bending moment and torsional moment
Vertical Stabilizer	6-component	Vertical stabilizer normal force, side force, axial force, pitching moment, bending moment, and torsional moment
Inboard Elevon	1-component	Inboard elevon hinge moment
Outboard Elevon	1-component	Outboard elevon hinge moment
Dual Stings	4-component (each)	Launch vehicle normal force, side force, and pitching moment (used to calculate sting deflections)

The orbiter was mounted on the Task MK XXII 1.5-inch diameter balance during the first entry. This balance proved to be too flexible resulting in excessive deflections of the orbiter relative to the ET and SRB's and fouling between the metric and non-metric parts. On September 14 this balance was purposely "caged" to reduce the deflections. Quantitative determination of the effectiveness of the caging was performed and deflections were satisfactory. None of the data obtained from this balance is considered reliable. The model was modified for the second entry and mounted on the Task MK XXII 2.5-inch diameter balance. This larger, stiffer balance reduced the deflections approximately 50% and eliminated the fouling problems.

An AEDC supplied angular position indicator (dangleometer) was mounted in the external tank, and was used only as a check at 0^{o} roll angles during the test. Due to the erratic nature of the data, particularly at roll angles other than 0^{o}, it was eliminated from the data printout.

The pressure transducers were calibrated prior to the test and were again calibrated after the model was installed in the tunnel using the "reference" and "calibrate" ports on the Scanivalves in accordance with normal AEDC/PWT procedures.

After installation all pressures were either leak checked using a hand-held vacuum pump or continuity checked with compressed air when the orifice was located in a position where it could not be leak checked. This checking continued throughout the test whenever there was any evidence of a problem and after model changes to check all pressures which had been disconnected during the change.

The 2 1/2-inch MK XXII balance, the wing balance, the vertical tail balance and the elevon beams were calibrated in the AEDC calibration laboratory prior to the test. The elevon hinge moment gauges were calibrated in the tunnel after the model was installed, and were check calibrated after each change in elevon angle. All balances were check-loaded after the model was installed in the tunnel.

After installation in the model, the dangleometer was calibrated over the angle-of-attack range required for the test.

The general test procedure was as follows: After starting the tunnel, the desired test conditions for a particular Mach number (the lowest required for the subject configuration) were established as given in Table I. Data were obtained during a pause at each required angle-of-attack and sideslip. After data were obtained for the required angle matrix, the test conditions were changed to the next higher Mach number and the process was repeated. After all data on a particular configuration had been obtained, the tunnel was shut down for a model change to the next scheduled elevon setting. Periodically, the AADS probe was rotated in 90-degree increments so that data were obtained on the AADS pressure taps in four different positions. The change from the "pressure" to the "force" vertical tail was made during the non-running shift to provide sufficient time to check out the balance. The SILTS pod was also removed during a non-running shift to minimize model change time during the running shift.

DATA REDUCTION

Standard AEDC methods for computing tunnel parameters, balance forces and moments, and model attitudes were used. Pressure coefficients were calculated for all model pressures. Force and moment coefficients (body axis system only) were computed for each balance using the axis system defined in Figure 1a. Orbiter force and moment data were adjusted to account for the difference between measured base pressure and freestream pressure. Elevon hinge moments, and wing and vertical tail forces and moments were calculated in coefficient form about reference locations specified for each component.

The moment reference locations, in full-scale dimensions, are as follows:

Total vehicle (Used for orbiter data):	X_T 976, Y_T0, Z_T 400
Right wing:	X_o 1307, Y_o 105
Right elevons:	Hingeline at X_o 1387
Vertical tail:	X_o 1414.3, Z_o 503

The attitude of the external tank/SRB's was calculated from the sector reading and the output of the strain gauges on the forked sting. Balance deflections were accounted for in determining the attitude of the orbiter. The deflection of the elevons and the vertical tail due to applied loads were also calculated. The deflection of the wing under load was found to be insignificant and therefore was not accounted for in data reduction.

Pressure coefficients were computed as follows:

$$C_{p_i} = (P_i - P_o)/q$$

where "i" represents the model orifice number.

Standard six component body axis force coefficients were computed for the balance mounted orbiter. The reference area used was the orbiter wing area, and the reference length for moment coefficients was the orbiter reference length. Moments were computed at the integrated vehicle reference center which is at the orbiter nose on the tank centerline. This is located at $X_T = 976$, $Y_T = 0$, $Z_T = 400$ in tank coordinates, and $X_o = 235$, $Y_o = 0$, $Z_o = 63.5$ in orbiter coordinates. The balance transfer dimensions are depicted in Figures 1b through 1d.

The normal force, axial force, and pitching moment coefficients for the orbiter were adjusted for base pressure as follows:

$$C_{N_B} = \frac{-1}{S_w} \tan 14.75^o \sum_{301}^{324} C_{p_i} A_i + \frac{-1}{S_w} \sum_{401}^{440} C_{p_i} A_i$$

$$C_{A_B} = \frac{-1}{S_w} \sum_{301}^{324} C_{p_i} A_i$$

$$C_{m_B} = \frac{-1}{S_w \ell_b} \left[-X_1 \tan 14.75^o \sum_{301}^{324} C_{p_i} A_i - X_2 \sum_{401}^{440} C_{p_i} A_i + Z_1 \sum_{301}^{324} C_{p_i} A_i \right]$$

where X_1, X_2 and Z_1 are the distances to the centroid of the area from the moment reference center.

The resulting coefficients are applied as follows to obtain the forebody coefficients:

$$C_{A_f} = C_{A_u} - C_{A_B}$$

$$C_{N_f} = C_{N_u} - C_{N_B}$$

$$C_{m_f} = C_{m_u} - C_{m_B}$$

The model component loads were reduced to force and moment coefficients in the following manner:

For wing bending and torsion:

$$C_{N_w} = N_w / \left[(q)(S_w)\right]$$

$$C_{B_w} = B_w / \left[(q)(S_w)(b_w)\right]$$

$$C_{T_w} = T_w / \left[(q)(S_w)(\bar{c})\right]$$

For vertical tail bending and torsion:

$$C_{S_v} = N_{vt} / \left[(q)(S_{vt})\right]$$

$$C_{B_v} = B_{vt} / \left[(q)(S_{vt})(C_{vt})\right]$$

$$C_{n_v} = T_{vt} / \left[(q)(S_{vt})(C_{vt})\right]$$

(Data from the vertical tail pitching moment gauge were not reduced.)

For elevon hinge moments:

$$C_{h_{e_i}} = H_{e_i} / \left[(q)(S_e)(C_e)\right]$$

$$C_{h_{e_o}} = H_{e_o} / \left[(q)(S_e)(C_e)\right]$$

The flow angularity corrections for alpha and beta were revised after completion of this test. Force data presented in this report are the second entry data received by DMS on April 17, 1980 with the final flow angularity corrected alpha and beta. Elevon deflection angles were also corrected for loads. (See References 7 and 8.) The data are tabulated in the Appendix and carry the two letter test code of 8M. This designates the DMS special request under which the corrections were performed and documented. These data may also be found in plotted form in the IA183 test documentation (Reference 9). The angles of attack and sideslip of the pressure data presented in Volumes 2 and 3 of this report have not been corrected for flow angularity and may differ from the force data presented herein.

A schedule of completed runs is given in Table II which is the Data Set/ Run Number Collation Summary for the test.

Reference dimensions and constants used were:

SYMBOL	VALUE: MODEL SCALE	VALUE: FULL SCALE	DESCRIPTION	
A_{301}	- 0 -		Orbiter base area for pressure tap	301
A_{302}	0.022146 ft.^{2}			302
A_{303}	0.122387			303
A_{304}	0.005970			304
A_{305}	0.004909			305
A_{306}	0.009287			306
A_{307}	0.007960			307
A_{308}	0.010613			308
A_{309}	0.022554			309
A_{310}	0.003980			310
A_{311}	0.023217			311
A_{312}	0.016584			312
A_{313}	0.001327			313
A_{314}	0.011940			314
A_{315}	0.013798			315
A_{316}	0.007297			316
A_{317}	0.012603			317
A_{318}	0.017247			318
A_{319}	0.021758			319

DATA REDUCTION (Continued)

SYMBOL	VALUE MODEL SCALE	VALUE FULL SCALE	DESCRIPTION	
A_{320}	0.015920		Orbiter base area for pressure tap	320
A_{321}	0.017247			321
A_{322}	0.014328			322
A_{323}	0.006103			323
A_{324}	0.026003			324
A_{401}	- 0 -		Body flap base area for pressure tap	401
A_{402}	- 0 -			402
A_{403}	- 0 -			403
A_{404}	- 0 -			404
A_{405}	0.01151 ft.^{2}			405
A_{406}	0.010267 ft.^{2}			406
A_{407}	0.0089838 ft.^{2}			407
A_{408}	0.0077004 ft.^{2}			408
A_{409}	- 0 -			409
A_{410}	- 0 -			410
A_{411}	- 0 -			411
A_{412}	- 0 -			412
A_{413}	0.012834 ft.^{2}			413
A_{414}	0.012834 ft.^{2}			414
A_{415}	0.012834 ft.^{2}			415

SYMBOL	VALUE MODEL SCALE	VALUE FULL SCALE	DESCRIPTION	
A_{416}	0.012834 ft.^{2}		Body flap base area for pressure tap	416
A_{417}	- 0 -			417
A_{418}	- 0 -			418
A_{419}	- 0 -			419
A_{420}	- 0 -			420
A_{421}	- 0 -			421
A_{422}	- 0 -			422
A_{423}	- 0 -			423
A_{424}	- 0 -			424
A_{425}	- 0 -			425
A_{426}	- 0 -			426
A_{427}	- 0 -			427
A_{428}	- 0 -			428
A_{429}	- 0 -			429
A_{430}	- 0 -			430
A_{431}	- 0 -			431
A_{432}	- 0 -			432
A_{433}	- 0 -			433
A_{434}	- 0 -			434
A_{435}	- 0 -			435
A_{436}	- 0 -			436

DATA REDUCTION (Continued)

SYMBOL	VALUE: MODEL SCALE	VALUE: FULL SCALE	DESCRIPTION
A_{437}	.011551 ft.^{2}		Body flap base area for pressure tap 437
A_{438}	.010267 ft.^{2}		438
A_{439}	.0089838 ft.^{2}		439
A_{440}	.0077004 ft.^{2}		440
b	38.709 in.	1290.3 in.	Orbiter reference length
b_w	28.101 in.	936.7 in.	Wing bending reference length
$\bar{c}$	14.244 in.	474.8 in.	Mean aerodynamic chord
C_e	2.721 in.	90.7 in.	Elevon reference chord length
C_{vt}	5.994 in.	199.8 in.	Vertical tail reference chord length
S_w	2.421 ft.^{2}	2690. ft.^{2}	Wing reference area
S_{vt}	0.3719 ft.^{2}	413.25 ft.^{2}	Vertical tail reference area
X_1	37.890 in.		Base pressure transfer distance
X_2	39.890 in.		Base pressure transfer distance
X_T	- 25.570 in.	-852.33 in.	Longitudinal transfer distance from orbiter balance reference point to integrated vehicle MRC
X_{TV}	2.341 in.	78.03 in.	Longitudinal transfer distance from vertical tail balance reference center to vertical tail MRC
Z_1	9.795 in.	-326.5 in.	Base pressure transfer distance

DATA REDUCTION (Concluded)

SYMBOL	VALUE MODEL SCALE	FULL SCALE	DESCRIPTION
Z_T	-9.795 in.	-326.5 in.	Vertical transfer distance from orbiter balance centerline to integrated vehicle MRC
Z_{TV}	0.632 in.	21.07 in.	Vertical transfer distance from vertical tail balance centerline to vertical tail MRC
S_e	0.189 ft.^{2}	210.0 ft.^{2}	Elevon reference area.

UNCERTAINTY OF MEASUREMENTS

The uncertainty levels quoted below are from the facility (Reference 5). These numbers represent a band containing 95% of the data and are derived from multiple calibrations of the instruments and from the repeatability and uniformity of the test section flow during tunnel calibration.

Balance	M_∞	α/β	ΔCNF	ΔCY	ΔCAF	ΔCLMF	ΔCBL	ΔCYN
Orbiter	0.60	4/-8	0.0078	0.0038	0.0018	0.0052	0.0005	0.0025
	↓	0/-8	0.0075	0.0039	0.0018	0.0051	0.0005	0.0026
	0.90	4/-4	0.0056	0.0028	0.0013	0.0038	0.0002	0.0019
	↓	0/-4	0.0056	0.0028	0.0013	0.0037	0.0002	0.0019
	1.25	4/-4	0.0047	0.0023	0.0011	0.0032	0.0002	0.0016
	↓	0/-4	0.0047	0.0023	0.0013	0.0031	0.0002	0.0016
	1.40	4/-4	0.0045	0.0023	0.0011	0.0030	0.0002	0.0015
	↓	0/-4	0.0045	0.0022	0.0011	0.0030	0.0002	0.0015

Balance	M_∞	α/β	CNW	CBW	CTW
Wing	0.60	4/-8	0.0029	0.0004	0.0017
	↓	0/-8	0.0028	0.0004	0.0017
	0.90	4/-4	0.0021	0.0003	0.0013
	↓	0/-4	0.0021	0.0003	0.0013
	1.25	4/-4	0.0018	0.0002	0.0011
	↓	0/-4	0.0018	0.0002	0.0011
	1.40	4/-4	0.0018	0.0002	0.0011
	↓	0/-4	0.0018	0.0002	0.0011

Balance	M_∞	α/β	CZV	CSV	CAV	CMV	CBV	CTV
Vertical Tail	0.60	4/-8	0.0091	0.0101	0.0109	0.0050	0.0037	0.0047
	↓	0/-8	0.0091	0.0101	0.0109	0.0050	0.0039	0.0047
	0.90	4/-4	0.0068	0.0072	0.0081	0.0037	0.0025	0.0035
	↓	0/-4	0.0068	0.0073	0.0081	0.0037	0.0025	0.0035
	1.25	4/-4	0.0057	0.0061	0.0068	0.0031	0.0021	0.0029
	↓	0/-4	0.0057	0.0061	0.0068	0.0031	0.0021	0.0029
	1.40	4/-4	0.0055	0.0059	0.0066	0.0030	0.0020	0.0028
	↓	0/-4	0.0055	0.0059	0.0066	0.0030	0.0020	0.0028

Balance	M_∞	α/β	CHEI	CHEO
Inboard	0.60	4/-8	0.0040	0.0031
& Out-	↓	0/-8	0.0040	0.0031
board	0.90	4/-4	0.0029	0.0023
Elevons	↓	0/-4	0.0029	0.0023
│	1.25	4/-4	0.0025	0.0019
│	↓	0/-4	0.0025	0.0019
│	1.40	4/-4	0.0024	0.0019
↓	↓	0/-4	0.0024	0.0019

The uncertainties in model angle of attack and sideslip resulting from uncertainties in sting pitch, sting roll, and sting/balance deflections were estimated to be ±0.10 deg. The uncertainty in the determination of flow angularity correction was estimated to be ±0.10 deg. In combined form, the final uncertainties in model angle of attack and sideslip are estimated to be ±0.14 deg.

Pressure coefficient uncertainties are estimated to be as follows for test conditions where the Scanivalve® calculations indicated no malfunctions.

	CP	CP	CP	CP
M_∞	-1.0	-0.5	0.5	1.0
0.60	±0.0220	±0.0199	±0.0178	±0.0182
0.90	±0.0144	±0.0137	±0.0130	±0.0132
1.25	---	±0.0110	±0.0109	±0.0110
1.40	---	±0.0105	±0.0105	±0.0106

REFERENCES

1. SD77=SH-0194, "Pretest Information for Test IA105A of the 0.03-Scale Pressure Loads Model 47-OTS of the Space Shuttle Integrated Vehicle in the 16-Ft Transonic Test Section of the Propulsion Wind Tunnel at AEDC," dated September 2, 1977.

2. STS-79-0016, "Pretest Information for Test IA184 of the 0.03-Scale Pressure Loads Model 47-OTS of the Space Shuttle Integrated Vehicle in the 9 x 7-Foot Supersonic Test Section of the Unitary Plan Wind Tunnel at Ames Research Center," dated March 5, 1979.

3. SD77-SH-0227, "Pretest Information for Test IA105B of the 0.03-Scale Pressure Loads Model 47-OTS of the Space Shuttle Integrated Vehicle in the 9-Foot by 7-Foot Supersonic Test Section of the Unitary Plan Wind Tunnel at NASA/Ames Research Center," dated October 12, 1977.

4. "Research Facilities Summary, Volume II - Wind Tunnels: Subsonic, Transonic, Supersonic," NASA/Ames Research Center, dated December 1965.

5. AEDC-DR-78-25, "Documentation of Wind Tunnel Tests of the NASA Space Shuttle Launch Vehicle Models", dated 16 March 1978.

6. AEDC-TMR-80-G21, "Six Tests of the NASA Space Shuttle Launch Vehicle in the AEDC 16-Ft. Transonic Wind Tunnel and the Corrections Applied to the Test Data", dated July 1980.

7. ARO, Inc. Letter of April 9, 1980 to D. E. Poucher from J. A. Black, subject, "Recomputed Space Shuttle Data from NASA/Rockwell Tests IA-105A, IA-156A, IA-105AR, IA-182, IA-183 (Project P43T-09)."

8. Rockwell International IL No. SAS/AERO/78-014, "Correction Requirements for IA105/156 Force and Moment Data," (April 25, 1978).

9. NASA-CR 160,488, DMS-DR 2444, "Results of Tests Using a 0.02-Scale Model (89-OTS) of the Space Shuttle Integrated Vehicle in the AEDC 16-foot Transonic Propulsion Wind Tunnel (IA183).

10. Rockwell International IL No. SAS/AERO/78-024," IA105A Second Entry Pressure Data Corrections," (March 24, 1978).

TABLE I

TEST : IA 105 A			DATE :
TEST CONDITIONS			
MACH NUMBER	REYNOLDS NUMBER (per unit length)	DYNAMIC PRESSURE (pounds/sq. ~~inch~~ ft)	STAGNATION TEMPERATURE (degrees Fahrenheit)
0.6	4.0×10^6	442	—
0.8		550	
0.9		698	
0.95		723	
1.05		763	
1.10		785	
1.15		804	
1.25	3.5×10^6	728	
1.40	3.5×10^6	752	
1.55	3.2×10^6	703	

BALANCE UTILIZED: see table IV

	CAPACITY:	ACCURACY:	COEFFICIENT TOLERANCE:
NF			
SF			
AF			
PM			
RM			
YM			

COMMENTS:

TABLE II

AEDC 16T-470

TEST: IA105A (1st Entry) *

DATA SET/RUN NUMBER COLLATION SUMMARY

DATE: 30 SEPT 1977

DATA SET IDENTIFIER	CONFIGURATION	β		δ_{eI}	δ_{eO}	Rn/L	Mach	φ					ANGLE OF ATTACK ~ α ~ DEG. 0				
R4B*01	ΦTS w/o SILTS	A		10	5		0.60	0					19				
02	PRESSURE TAIL						0.70						20				
03		B					0.80						22				
04							0.85						23				
05							0.90						24				
06							0.92						29				
07							0.94						30				
08							0.95						31				
09							0.96						32				
10							0.97						33				
11							0.98						34				
12							0.99						35				
13							1.01						36				
14							1.02						37				
15							1.03						38				
16							1.04						39				
17							1.05						40				
18							1.06						41				

TEST RUN NUMBERS

1 7 13 19 25 31 37 43 49 55 61 67 75 76

COEFFICIENTS IDVAR (1) IDVAR (2) NDV

α OR β SCHEDULES

A) $\beta = -4^\circ, 2^\circ, 0^\circ, 2^\circ, 4^\circ$

B) $\beta = -4^\circ, 0^\circ, 4^\circ$

* FORCE DATA FOR 2nd ENTRY ONLY PRESENTED HEREIN

TABLE II (Continued)

AEDC 16T-470

TEST: IA105A (1st Entry)

DATA SET/RUN NUMBER COLLATION SUMMARY

DATE: 30 SEPT 1977

DATA SET IDENTIFIER	CONFIGURATION	β		δ_{eI}	δ_{eO}	Rn/L	Mach	ϕ	ANGLE OF ATTACK ~ α ~ DEG								
													0				
R4B*19	ΦTS W/O SILTS	B		10	5	4.0	1.08	0					42				
20	PRESSURE TAIL						1.10						43				
21							1.15						44				
22						3.5	1.20						45				
23							1.25						46				
24						4.1	1.30						47				
25						3.5	1.40						48				
26						3.2	1.55						49				
27		4				4.0	0.95						50				

TEST RUN NUMBERS

1 7 13 19 25 31 37 43 49 55 61 67 75 76

α OR β SCHEDULES: B) $\beta = -4°, 0°, 4°$

COEFFICIENTS

IDVAR (1) IDVAR (2) NDV

TABLE II (Continued)

TEST: IA105A (1st Entry)

DATA SET/RUN NUMBER COLLATION SUMMARY

DATE: 30 SEPT 1977

DATA SET IDENTIFIER	CONFIGURATION	α	δ_{e_I}	δ_{e_O}	Rn/L	Mach	ϕ	β = -8	-6	-4	-2	0	2	4	6	8
								ANGLE OF SIDESLIP ~ β ~ DEG. (TEST RUN NUMBERS)								
R4B#28	ΦTS w/o SILTS	C	10	5	4.0	0.60	0	58	59	60		61		62	63	64
29	PRESSURE TAIL	D				0.80			65	66		67		68	69	
30						0.90			70	71		72		73	74	
31						0.95			79	78		77		76	75	
32						1.05			80	81				85	86	
33						1.10						92		87	89	
34						1.05			112	113		114		115	116	
35						1.10			117	118		119		120	125	
36						1.15			126	127		128		129	130	
37					3.5	1.25			131	132		133		134	135	
38					3.5	1.40			136	137		138		139	140	
39					3.2	1.55			141	142		143/146		144	145	
40	ΦTS + SILTS				4.0	0.60			151	152		153		154	155	
41	PRESSURE TAIL					0.80			156	157		158		159	160	
42						0.90			161	162		163		164	165	
43						0.95			166	167		168		169	170	
44						1.05			171	172		173		174	175	
45					3.5	1.25			176	177		178		179	180	

1 7 13 19 25 31 37 43 49 55 61 67 75 76

α OR β SCHEDULES

C) $\alpha = -8^\circ, -4^\circ, 0, 4^\circ, 8^\circ$ COEFFICIENTS

D) $\alpha = -8^\circ, -4^\circ, 0, 4^\circ$

IDVAR (1) IDVAR (2) NDV

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TABLE II (Continued)

TEST: IA105A (1st Entry)

DATA SET/RUN NUMBER COLLATION SUMMARY

DATE: 30 SEPT 1977

DATA SET IDENTIFIER	CONFIGURATION	α		δ_{e_I}	δ_{e_O}	Rn/L	Mach	ϕ		ANGLE OF SIDESLIP ~ β ~ DEG. -8	-6	-4	-2	0	2	4	6	8
R4B*46	ϕTS + SILTS	D		10	5	3.2	1.55	0			181	182		183		184	185	
47	PRESSURE TAIL					3.5	1.40				186	187		203		204	205	
48						4.0	1.10				193	194		195		196	197	
49							1.15				202	201		200		199	198	
50	ϕTS W/O SILTS	C			9		0.60			209		210		211		212		213
51	PRESSURE TAIL	E					0.80				214	215		216		217	218	
52		D					0.90				240	241		242		243	244	
53							0.95				235	236		237		238	239	
54							1.05				219	220		221		222	223	
55							1.10				224	225		226		227	228	
56							1.15				229			230			231	
57						3.5	1.25				232			233			234	
58					2	4.0	1.05				249			250			251	
59							1.10				252			253			254	
60							1.15				255	256		257		258	259	
61						3.5	1.25				260	261		262		263	264	
62						3.5	1.40				268			269			270	
63						3.2	1.55				271			272			273	

TEST RUN NUMBERS

1 7 13 19 25 31 37 43 49 55 61 67 75 76

α OR β SCHEDULES

C) $\alpha = -8^\circ, -4^\circ, 0^\circ, 4^\circ, 8^\circ$ COEFFICIENTS

D) $\alpha = -8^\circ, -4^\circ, 0^\circ, 4^\circ$

E) $\alpha = -8^\circ, -4^\circ, 0^\circ, 4^\circ, 6^\circ$

IDVAR (1) IDVAR (2) NDV

TABLE II (Continued)

AEDC 16T - 470

TEST: IA105A (1st Entry) — DATA SET/RUN NUMBER COLLATION SUMMARY — DATE: 30 SEPT 1977

DATA SET IDENTIFIER	CONFIGURATION	α	δ_{e_I}	δ_{e_O}	Rn/L	Mach	ϕ	ANGLE OF SIDESLIP ~ β ~ DEG. TEST RUN NUMBERS								
								-8	-6	-4	-2	0	2	4	6	8
R4B*64	ϕTS w/o SILTS	D	10	11	4.0	0.60	0	276		277		278		279		280
65	PRESSURE TAIL					0.80			281	282		283		284	285	
66						0.90			286	287		288		289	290	
67						0.95			292			291				
68	ϕTS w/o SILTS					0.95			298	299		300		301	302	
69	METRIC TAIL					1.05			303	304		305		306	307	
70						1.10			308			309			310	
71						1.15			311			312			313	
72		C		7		0.60		316		317		318		319		320
73		D				0.80			321	322		323		324	325	
74						0.90			326	327		328		353	329	
75						0.95			354	355		356		357	358	
76						1.05			359	360		361		362	363	
77						1.10			364	365		366		367	368	
78						1.15			336	337		338		339	340	
79					3.5	1.25			330			331			332	
80					3.5	1.40			333			334			335	

1 7 13 19 25 31 37 43 49 55 61 67 75 76

α OR β SCHEDULES — COEFFICIENTS — IDVAR (1) — IDVAR (2) — NDV

C) $\alpha = -8^\circ, -4^\circ, 0^\circ, -4^\circ, -8^\circ$

D) $\alpha = -8^\circ, -4^\circ, 0^\circ, 4^\circ$

AEDC 16T-470

TABLE II (Continued)

TEST: IA105A (1st Entry)

DATA SET/RUN NUMBER COLLATION SUMMARY

DATE: 30 SEPT 1977

DATA SET IDENTIFIER	CONFIGURATION	α	δ_{e_I}	δ_{e_O}	Rn/L	Mach	ϕ	ANGLE OF SIDESLIP ~ β ~ DEG. -8	-6	-4	-2	0	2	4	6	8
R4B*81	ϕTS + SILTS	D	10	-2	4.0	1.15	0		372			373			374	
82	METRIC TAIL				3.5	1.25			385	386		387		388	389	
83					3.5	1.40			375	376		377		378	379	
84					3.2	1.55			380	381		382		383	384	
85				-5	3.5	1.25			393			394			395	
86					3.5	1.40			396	397		398		399	400	
87					3.2	1.55			401	402		403		404	405	
88				0	4.0	1.10			411			412			413	
89					4.0	1.15			414			415			416	
90					3.5	1.25			417	418		419		420	421	
91					3.5	1.40			422	423		424		425	426	
92					3.2	1.55			427			428			429	
93				-7	3.5	1.40			433			434			435	
94				-7	3.2	1.55			436	437		438		439	440	
95			12	-2	4.0	1.15			443			444			445	
96					3.5	1.25			451			452		454	453	
97					3.5	1.40			446	447		448		449	450	
98		C		9	4.0	0.60		468		469		470		471		472

1 7 13 19 25 31 37 43 49 55 61 67 75 76

α OR β SCHEDULES

C) $\alpha = -8°, -4°, 0°, 4°, 8°$

D) $\alpha = -8°, -4°, 0°, 4°$

COEFFICIENTS

IDVAR (1) IDVAR (2) NDV

AEDC 16T-470

TABLE II (Continued)

TEST: IA105A (1st Entry) DATA SET/RUN NUMBER COLLATION SUMMARY DATE: 30 SEPT 1977

DATA SET IDENTIFIER	CONFIGURATION	α		δ_{ei}	δ_{eo}	Rn/L	Mach	ϕ		-8	-6	-4	-2	0	2	4	6	8
										ANGLE OF SIDESLIP ~ β ~ DEG.								
R4B*99	ΦTS + SILTS	E		12	9	4.0	0.80	0			473	474		475		476	477	
A1	METRIC TAIL	D					0.90				497	498		499		503	504	
A2							0.95				505	506		507		508	509	
A3							1.05				511	512		513		514	515	
A4							1.10				478	479		480		481	482	
A5							1.15				517			518			519	
A6						3.5	1.25				520			521			522	
A7						3.5	1.40				525			526			527	
A8						3.2	1.55				530			531			532	
A9				8		4.0	0.60			535		536		537		538		539
B1		E					0.80				555	556		557		558	559	
B2		D					0.90				561	562		563		564	565	
B3							0.95				566	567		568		569	570	
B4							1.05				571	572		573		574	575	
B5							1.10				540	541		542		543	544	
B6							1.15				576			577			578	
B7						3.5	1.25				579			580			581	
B8						3.5	1.40				582			583			584	

TEST RUN NUMBERS

1 7 13 19 25 31 37 43 49 55 61 67 75 76

α OR β SCHEDULES

D) $\alpha = -8°, -4°, 0°, 4°$ COEFFICIENTS

E) $\alpha = -8°, -4°, 0°, 4°, 6°$

IDVAR (1) IDVAR (2) NDV

AEDC 16T-470

TABLE II (Continued)

TEST: IA105A (1st Entry)

DATA SET/RUN NUMBER COLLATION SUMMARY

DATE: 30 SEPT 1977

TEST RUN NUMBERS

DATA SET IDENTIFIER	CONFIGURATION	α		δ_{e_I}	δ_{e_O}	Rn/L	Mach	ϕ		ANGLE OF SIDESLIP ~ β ~ DEG. -8	-6	-4	-2	0	2	4	6	8
R4B* B9	ΦTS + SILTS	D		8	9	3.2	1.55	0			585			586			587	
C1	METRIC TAIL	F				4.8	1.10							588				
C2						4.0								589				
C3						3.2								592				
C4						2.5								593				
C5						3.2		180						545				
C6						2.5								546				
C7						2.0								547				
C8		D			-2	4.0	1.15	0			597			598			599	
C9						3.5	1.25				600	604		601		603	602	
D1						3.5	1.40				605	606		607		608	609	
D2						3.2	1.55				610	611		612		613	614	

1 7 13 19 25 31 37 43 49 55 61 67 75 76

COEFFICIENTS IDVAR (1) IDVAR (2) NDV

α OR β SCHEDULES

D) $\alpha = -8^\circ, -4^\circ, 0^\circ, 4^\circ$

F) $\alpha = 0^\circ, 4^\circ, 6^\circ$

TABLE II (Continued)

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TEST: IA105A (1st Entry)

DATA SET/RUN NUMBER COLLATION SUMMARY

DATE: 30 SEPT 1977

DATA SET IDENTIFIER	CONFIGURATION	β	δ_{eI}	δ_{eO}	Rn/L	Mach	ϕ	ANGLE OF ATTACK ~ α ~ DEG. 0	2	4	6
R4B*D3	ΦTS + SILTS	B	12	9	2.5	0.60	0	467			
D4	METRIC TAIL					0.90				510	
D5						1.10				516	
D6						1.25				523	
D7		G				1.25				524	
D8						1.55				528	
D9					3.2	1.55				529	
E1	ΦTS W/O SILTS		8		4.0	1.10	90	590			
E2	METRIC TAIL		8			1.10	-90	591			
E3		H	10	7		0.80	0				352

TEST RUN NUMBERS

1 7 13 19 25 31 37 43 49 55 61 67 75 76

COEFFICIENTS IDVAR (1) IDVAR (2) NDV

α OR β SCHEDULES

B) $\beta = -4°, 0, 4°$ H) $\beta = -6°, -4°, 0, 4°, 6°$

G) $\beta = -6°, 0, 6°$

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TABLE II (Continued)

TEST: IA105A (2nd Entry)

DATA SET/RUN NUMBER COLLATION SUMMARY

DATE: 1 Feb 1978

DATA SET IDENTIFIER	CONFIGURATION	β	δ_{eI}	δ_{eO}	Rn/L	Mach	ANGLE OF ATTACK ~ α ~ DEG. -8	-6	-4	-2	0	2	4	6	8
R4F*01	ΦTS w/o SILTS	H	8	-7	3.5	1.40	1770		1771		1772		1773		
2				-7	3.2	1.55	1774		1775		1776		1777		
3				-2	3.5	1.15	1968		1969		1970		1971		
4						1.25	1972		1973		1974		1975		
5						1.40	1976		1977		1978		1979		
6					3.2	1.55	1980		1981		1982		1983		
7	ΦTS + SILTS	B		5	3.5	0.60	1880		1881		1882		1883		1884
8		H				0.80	1886		1887		1888		1889	1890	
9		J				0.90	1893	1894	1895	1896	1897	1898	1899		
10		H				0.95	1901		1902		1903		1904		
11		J				1.05	1907	1908	1909	1910	1911	1912	1913		
12		H				1.10	1914		1915		1916		1941		
13		H				1.15	1918		1919		1920		1921		
14		J				1.25	1923	1924	1925	1926	1927	1928	1929		
15		H				1.40	1931		1932		1933		1934		
16		H			3.2	1.55	1936		1937		1938		1939		
17	ΦTS w/o SILTS	B		9	3.5	0.60	1733		1734		1735		1736		1737
18		H		9	3.5	0.80	1738		1739		1740		1741	1742	

1 7 13 19 25 31 37 43 49 55 61 67 75 76

α OR β SCHEDULES

B) $\beta = -4°, 0, 4°$

H) $\beta = -6°, -4°, 0°, 4°, 6°$

COEFFICIENTS

J) $\beta = -8°, -4°, 0°, 4°, 8°$

IDVAR (1) IDVAR (2) NDV

TABLE II (Continued)

AEDC 16T-470

TEST : IA105A (2nd Entry)

DATA SET/RUN NUMBER COLLATION SUMMARY

DATE : 1 Feb 1978

DATA SET IDENTIFIER	CONFIGURATION	β	δ_{eI}	δ_{eO}	Rn/L	Mach	ANGLE OF ATTACK ~ α ~ DEG. −8	−6	−4	−2	0	2	4	6	8
R4F#37	ØTS W/O SILTS	H	10	5	3.5	0.90	1541		1542		1543		1544		
38						0.95	1545		1546		1547		1548		
39						1.05	1549		1550		1551		1552		
40						1.10	1553				1561		1562		
41						1.15	1563	1564	1565		1566		1564		
42						1.25	1568		1569		1570		1571		
43						1.40	1573		1575		1577		1578		
44					3.2	1.55	1579		1580		1581		1582		
45	ØTS + SILTS	B		9	3.5	0.60	1619		1620		1621		1622		1623
46		H				0.80	1614		1615		1616		1617	1618	
47						0.90	1588		1589		1590		1591		
48						0.95	1592		1593		1594		1595		
49						1.05	1596		1597		1598		1599		
50						1.10	1600		1602		1603		1604		
51						1.15	1605		1606		1607		1608		
52						1.25	1609		1610		1611		1612		
53	ØTS W/O SILTS	B		11		0.60	2049		2050		2051		2052		2053
54		H		11		0.80	2044		2045		2046		2047	2048	

TEST RUN NUMBERS

1 7 13 19 25 31 37 43 49 55 61 67 75 76

COEFFICIENTS IDVAR (1) IDVAR (2) NDV

α OR β SCHEDULES

B) $\beta = -4°, 0°, 4°$

H) $\beta = -6, -4°, 0°, 4°, 6°$

AEDC 16T-470

TABLE II (Continued)

TEST: IA105A (2nd Entry)

DATA SET/RUN NUMBER COLLATION SUMMARY

DATE: 1 Feb 1978

DATA SET IDENTIFIER	CONFIGURATION	β	δ_{eI}	δ_{eO}	Rn/L	Mach	α = -8	-6	-4	-2	0	2	4	6	8
R4F*19	ΦTS w/o SILTS	H	8	9	3.5	0.90	1743		1744		1745		1746		
20						0.95	1747		1748		1749		1750		
21						1.05	1751		1752		1753		1754		
22						1.10	1755		1756		1757		1758		
23						1.15	1759		1760		1761		1762		
24						1.25	1763		1764		1765		1766		
25		B		11		0.60	1989		1990		1991		1992		1993
26		H				0.80	1994		1995		1996		1997	1998	
27						0.90	1999		2000		2001		2002		
28						0.95	2003		2004		2005		2006		
29						1.05	2007		2008		2009		2010		
30						1.10	2011		2012		2013		2014		
31	ΦTS + SILTS		10	-2		1.15	1631		1632		1633		1634		
32						1.25	1635		1636		1637		1638		
33						1.40	1639		1640		1641		164		
34					3.2	1.55	1646		1647		1648		1649		
35	ΦTS w/o SILTS	B		5	3.5	0.60	1528		1529		1530		1531		1532
36		H		5	3.5	0.80	1536		1537		1538		1539	1540	

TEST RUN NUMBERS

1 7 13 19 25 31 37 43 49 55 61 67 75 76

α OR β SCHEDULES

B) $\beta = -4^\circ, 0^\circ, 4^\circ$

H) $\beta = -6^\circ, -4^\circ, 0^\circ, 4^\circ, 6^\circ$

COEFFICIENTS

IDVAR (1) IDVAR (2) NDV

AEDC 16T-470

TABLE II (Continued)

TEST: IA105A (2nd Entry)

DATA SET/RUN NUMBER COLLATION SUMMARY

DATE: 1 Feb 1978

DATA SET IDENTIFIER	CONFIGURATION	β	δ_{eI}	δ_{eO}	Rn/L	Mach	ANGLE OF ATTACK ~ α ~ DEG. -8	-6	-4	-2	0	2	4	6	8
R4F*55	ΦTS w/o SILTS	H	10	11	3.5	0.90	2039		2041		2042		2043		
56						0.95	2027		2028		2029		2030		
57						1.05	2031		2032		2033		2034		
58						1.10	2035		2036		2037		2038		
59			12	-7		1.40	1674		1675		1676		1677		
60				-7	3.2	1.55	1678		1679		1680		1681		
61				-2	3.5	1.15	1655		1655		1657		1658		
62						1.25	1659		1660		1661		1662		
63						1.40	1663		1664		1665		1666		
64					3.2	1.55	1667		1668		1669		1670		
65		B		5	3.5	0.60	1818		1819		1820		1821		1822
66		H				0.80	1823		1824		1825		1826	1845	
67		J				0.90	1827	1828	1829	1830	1831	1832	1833		
68		H				0.95	1834		1835		1836		1837		
69		J				1.05	1838	1839	1840	1841	1842	1843	1844		
70		H				1.10	1846		1847		1848		1849		
71		H				1.15	1850		1851		1852		1853		
72		J				1.25	1854	1855	1856	1857	1858	1859	1860		

TEST RUN NUMBERS

1 7 13 19 25 31 37 43 49 55 61 67 75 76

COEFFICIENTS IDVAR (1) IDVAR (2) NDV

α OR β SCHEDULES

B) $\beta = -4^\circ, 0^\circ, 4^\circ$

J) $\beta = -8^\circ, -4^\circ, 0^\circ, 4^\circ, 8^\circ$

H) $\beta = -6^\circ, -4^\circ, 0^\circ, 4^\circ, 6^\circ$

TABLE II (Continued)

AEDC 16T-470

TEST: IA105A (2nd Entry)

DATA SET/RUN NUMBER COLLATION SUMMARY

DATE: 1 Feb 1978

DATA SET IDENTIFIER	CONFIGURATION	β		δ_{eI}	δ_{eO}	Rn/L	Mach			α = −8	−6	−4	−2	0	2	4	6	8
R4F*73	ΦTS W/O SILTS	H		12	5	3.5	1.40			1861		1862		1863		1864		
74		H			5	3.2	1.55			1865		1866		1867		1868		
75		B			9	3.5	0.60			1694		1695		1696		1697		1728
76		H					0.80			1698		1699		1700		1701	1702	
77							0.90			1703		1704		1705		1711		
78							0.95			1707		1708		1710		1709		
79							1.05			1712		1713		1714		1715		
80							1.10			1716		1717		1718		1719		
81							1.15			1720		1721		1722		1723		
82							1.25			1724		1725		1726		1727		
83		B			11		0.60			1788		1789		1790		1791		1792
84		H					0.80			1793		1794		1795		1796	1797	
85							0.90			1798		1799		1800		1801		
86							0.95			1802		1803		1804		1805		
87							1.05			1806		1807		1808		1809		
88							1.10			1810		1811		1812		1813		

Column header over the α columns: ANGLE OF ATTACK ~ α ~ DEG.; TEST RUN NUMBERS

1 7 13 19 25 31 37 43 49 55 61 67 75 76

α OR β SCHEDULES

B) $\beta = -4^\circ, 0^\circ, 4^\circ$

H) $\beta = -6^\circ, -4^\circ, 0^\circ, 4^\circ, 6^\circ$

COEFFICIENTS

IDVAR (1) IDVAR (2) NDV

TABLE II (Continued)

TEST: IA105A (2nd Entry)

DATA SET/RUN NUMBER COLLATION SUMMARY

DATE: 1 Feb 1978

DATA SET IDENTIFIER	CONFIGURATION	φ	Z	δ_{e_I}	δ_{e_O}	Rn/L	Mach			ANGLE OF ATTACK ~ α ~ DEG. 8	6	4	2	0	2	4	6	8
R4F#89	OTS w/o SILTS	L	1	8	-2	3.5	0.95				1957			1958			1959	
90			2				0.95				1960			1961				
91			1				1.10				1948			1949			1950	
92			2				1.10				1951			1952			1953	
93			3				1.10				1954			1955			1956	
94			1				1.40				1945			1946			1947	
95			1	10	11		0.80				2018			2019			2020	
96			3				0.80				2021			2022			2023	
97			3				0.95				2024			2025			2026	
98		K	1	12	5		1.40				1869							
99			2				1.40				1874			1876			1875	
00			3				1.40				1873			1872			1871	

TEST RUN NUMBERS

1 7 13 19 25 31 37 43 49 55 61 67 75 76

α OR β SCHEDULES

COEFFICIENTS

K) $\phi = 0°, \pm 30°, \pm 60°, \pm 90°, \pm 100°$

L) $\phi = 0°, \pm 90°$

IDVAR (1) IDVAR (2) NDV

Z) 1 = 62.5" 2 = 74.0" 3 = 87.4"

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TABLE II (Continued)

TEST : IA105A (2nd Entry)

DATA SET/RUN NUMBER COLLATION SUMMARY

DATE : 1 Feb 1978

DATA SET IDENTIFIER	CONFIGURATION	β		δ_{eI}	δ_{eO}	Rn/L	Mach			ANGLE OF ATTACK ~ α ~ DEG. 8	6	4	2	0	2	4	6	8
R4F*R1	ΦTS + SILTS	0		8	5	3.5	0.60									1885		
R2							0.80									1891		
R3							0.90									1900		
R4							0.95									1905		
R5							1.10									1917		
R6							1.15									1922		
R7							1.25									1930		
R8							1.40									1935		
R9						3.2	1.55									1940		

TEST RUN NUMBERS

1 7 13 19 25 31 37 43 49 55 61 67 75 76

α OR β SCHEDULES

COEFFICIENTS

IDVAR (1) IDVAR (2) NDV

TABLE II (Continued)

Sweep Schedules:

A) β = -4,2,0,2,4	G) β = -6,0,6
B) β = -4,0,4	H) β = -6,-4,0,4,6
C) α = -8,-4,0,4,8	J) β = -8,-4,0,4,8
D) α = -8,-4,0,4	K) ϕ = 0,±30,±60,±90,±100
E) α = -8,-4,0,4,6	L) ϕ = 0,±90
F) α = 0,4,6	

Pressure Data 4th Character ID	Description
B	Orbiter Fuselage
E	Orbiter Base
F	Body Flap - lower surface
G	Body Flap - upper surface
J	Miscellaneous
L	Wing - lower surface
M	ET - protuberances
N	SRB - protuberances
O (numeric)	Orbiter force data (see below)
S	SRB surface
T	ET surface
U	Wing - upper surface
V	Vertical Tail

Force Data 1st Character ID	1st Ind. Var.	2nd Ind. Var.	Coefficients
R	ALPHAO	BETAO	CN CNF CA CAF CLM CLMF CY CYN CBL BETAS
S	ALPHAO	BETAO	CNW CTW CBW CHEI CHEO IB-ELV OB-ELV ALPHAI PHII MACH
T	ALPHAO	BETAO	CAVU CAV CSV CZV CMV CTV CBV ALPHAT BETAT ALPHAS
U	ALPHAO	BETAO	MACH P PT Q(PSF) TT RN/L AFA BFA ALFC
V	ALPHAO	BETAO	ALFAOU BETAOU ALFETU BETETU ALFASU BETASU DEINR DEONR
W	ALPHAO	BETAO	CNB CAB CLMB CABVT XCPV ZCPV CNSTNG

TABLE II (Concluded)

R dataset pages 1-113
S dataset pages 114-225
T dataset pages 227-339
U dataset pages 340-452
V dataset pages 453-555
W dataset pages 556-678

First Entry (Volume II) Pressure Data

Pressure Data 4th Character ID	Description	Print Normal Page No.	Microfiche Page No.
B	Orbiter Fuselage	1-2486	1-40
E	Orbiter Base	10,091-10,733	162-175
F	Body Flap - lower surface	10,734-11,291	175-181
G	Body Flap - upper surface	11,292-11,849	181-189
J	Miscellaneous	11,850-12,311	190-197
L	Wing - lower surface	2487-6309	40-101
M	ET - protuberances	12,312-15,997	197-255
N	SRB - protuberances	15,998-16,834	255-269
S	SRB surface	16,835-18,443	269-294
T	ET surface	18,444-21,623	294-345
U	Wing - upper surface	6310-9761	101-156
V	Vertical Tail	9762-10,090	156-161

Second Entry (Volume III) Pressure Data

Pressure Data 4th Character ID	Description	Print Normal Page No.	Microfiche Page No.
B	Orbiter Fuselage	1-203	1-4
E	Orbiter Base	1937-2646	31-43
F	Body Flap - lower surface	2647-3243	43-52
G	Body Flap - upper surface	3244-3840	52-62
J	Miscellaneous	3841-3953	62-63
L	Wing - lower surface	204-877	4-14
N	SRB - protuberances	3954-4150	63-66
S	SRB surface	4151-5187	66-83
T	ET surface	5188-6475	83-103
U	Wing - upper surface	878-1936	15-31

TABLE III. ELEVON DEFLECTION ANGLES

INBOARD ELEVON ANGLES, DEGREES		
NOMINAL	LEFT HAND MEASURED	RIGHT HAND MEASURED
12	12.45	12.683
10	10.58	10.250
8	8.32	8.533
4	4.45	4.58
0	0	0

OUTBOARD ELEVON ANGLES, DEGREES		
NOMINAL	LEFT HAND MEASURED	RIGHT HAND MEASURED
+2	2.23	2.42
0	0	0
-2	-1.78	-1.833
-5	-4.98	-4.98
-7	-6.88	-6.90

TABLE IV. BALANCES UTILIZED

ORBITER BALANCE - 1ST ENTRY

Task 1.5" MK XXII

COMP	RATED LOAD
N_1	2000 lbs
N_2	2000 lbs
A	600 lbs
Y_1	1000 lbs
Y_2	1000 lbs
ℓ	1600 in-lbs

ORBITER BALANCE - 2ND ENTRY

Task 2.5" MK XXII

COMP	RATED LOAD
N_1	2500 lbs
N_2	2500 lbs
A	800 lbs
Y_1	1000 lbs
Y_2	1000 lbs
ℓ	4000 in-lbs

VERTICAL TAIL BALANCE

Lockheed 1" 10033

COMP	RATED LOAD
Normal	700 lbs
Side	500 lbs
Axial	125 lbs
Roll	1200 in-lbs

TABLE IV. BALANCES UTILIZED (Concluded)

WING LOAD INDICATOR

COMP	RATED LOAD
Normal	378 lbs
Bending	1850 in-lbs
Torsion	938 in-lbs

ELEVON HINGE MOMENTS

COMP	RATED LOAD
Inboard	110 in-lbs
Outboard	110 in-lbs

GAGED STINGS

2" AEDC Stings - 4 Components each

Used for sting deflection determination only - rated loads unknown.

TABLE V

BAD PRESSURE DATA LIST
FIRST ENTRY

COMPONENT	DATA SET IDENTIFIER	β	α	TAP NUMBER
ORBITER FUSELAGE	R4BB28	-8	4	97→104
		-6	-8	97→104
		-8	-4,-8,0	98
		-8	8	97
		-6	-4	98
		-6	0,4,8	97,98
		-4	ALL	97,98
		0	ALL	96,97,98
	R4BB29	4	-8	103,104,106→111
		4	4	108→111
	R4BB30	-6	-4	97→104
		-4	4	98→102
		-4,4,6	-8	97→104
	R4BB32	-4	4	97→104
		0	ALL	46,56,95,96,97,99→102
	R4BB36	6	-8	141
	R4BB57	6	ALL	112
	R4BB58	-6	-8,0	33→40
		0	-8	33→40
		6	-4	33→40
	R5BB59	6	4	33→40
	R4BB60	0	4	33→40
		4	0	33→40
	R4BB98 → R4BBE2	ALL	ALL	192
	R4BBD3	ALL	ALL	184
ORBITER BASE	R4BE28 → R4BE53	ALL	ALL	311,312
	R4BE68 → R4BEE3	ALL	ALL	301,302,308
BODY FLAP - LOWER SURFACE	R4BF28 → R4BFE3	ALL	ALL	420
	R4BF58	-6	-8,0	428,433→436
		0	-8	428,433→436
		6	-4	428,433→436

TABLE V (Continued)

BAD PRESSURE DATA LIST
FIRST ENTRY

COMPONENT	IDENTIFIER	β	α	TAP NUMBER
BODY FLAP - LOWER SURFACE (Contd)	R4BF59	6	4	428,433→436
	R4BF60	-4	-4,0	428
		0	-8,4	428
		0	4	433→436
		4	0	428,433→436
	R4BF61	-6,-4	-8	417
	R4BF64	-8	-8	435
BODY FLAP - UPPER SURFACE	R4BG58	-6	-8,0	429→432, 437→440
		0	-8	" "
		6	-4	" "
	R4BG59	-6	4	429
		6	4	429→432, 437→440
	R4BG60	-4	-4,0	429
		0	-8	429
		0	4	429→432, 437→440
		4	0	429→432, 437→440
WING - LOWER SURFACE	R4BL28 →R4BLE3	ALL	ALL	618,619
	R4BL28	ALL	ALL	900
		-8	4	103,104,786,802→818,833→847
		-8	8	809,810,818,833→847
		-6	-8	103,104,809→816,818,833→847
		-6,-4,0,4	ALL	685
	R4BL29	ALL	ALL	900
		4	-8	809→816,818,834→844
		-6,-4,0,4	ALL	685
	R4BL30	ALL	ALL	900
		-6	-4	103,104,809→816,818,834→844
		-4	4	810→816,844
		-4,4,6	-8	103,104
		4,6	-8	809→816,818,833→844
	R4BL31	ALL	ALL	900
	R4BL32	-4	4	103,104,809→816,818,833→844
		ALL	ALL	872
	R4BL33	0	-4	103,104,809→816,818,833→844
		4	4	809→816,818,833→844
		6	0	812→816,833
	R4BL34	-6	-4	103,104,809→816,818,833→844
		-4	0,4	"

TABLE V (Continued)

BAD PRESSURE DATA LIST
FIRST ENTRY

COMPONENT	IDENTIFIER	β	α	TAP NUMBER
WING - LOWER SURFACE (Contd)	R4BL35	-6	0	103,104,809→816,818,833→844
		-4	4	"
		0	-8	"
		0	0	"
		4	-8	"
		6	4	"
	R4BL36	-6	-8,-4,0	"
		0,4	4	809→816,818,833→844
	R4BL37	-4	-8,-4	103,104,809→816,818,833→844
		4	4	103,104
		4	0,4	809→816,818,833→844
		4	-8	809,810,811,833→844
	R4BL38	-6	-4	809→816,818,833→844
		-4	0	103,104,809→816,818,833→844
		0	4	809→816,818,833→844
		4	0,4	809→816,833→844
		6	-4	104,809→816,818,833→844
	R4BL39	-6	-8	103,104,809→816,818,833→844
		-6	-4,0	810→816
		-6	-4	818
		-6	0	818,834→844
		0	-4	103,104,818,834→844
		0	-4,0	809→816
		0	0,4	818,834→844
		0	4	810→816
		4	-4,4	809→816
		4	4	818,834→844
		4	-4	103,104,818,833→844
		6	-8	103,104
		6	-8,0	809→816,818,833→844
	R4BL58	ALL	ALL	781
	R4BL64	ALL	ALL	900
	R4BL66	ALL	ALL	872
	R4BL67	ALL	ALL	748,872,902
	R4BL68	ALL	ALL	748
		-6	-8,-4	872
		0	0,4	900
		4,6	ALL	900

TABLE V (Continued)

BAD PRESSURE DATA LIST
FIRST ENTRY

COMPONENT	IDENTIFIER	β	α	TAP NUMBER
EXTERNAL TANK - PROTUBERANCES	R4BM32	ALL	ALL	1600→1650
	R4BM75	-6	-4	ALL
	R4BMA2	-6	-4,4	1767→1797
		-4,4	4	1767→1794
	R4BMA3	6	-4,0	1767→1786
	R4BMA4	6	4	1767→1786
	R4BMA7	6	-4	1767→1786
	R4BMB2	-6	-8	1767→1797
		-6	-4	1762→1798
		-6	4	1767→1798
		-4	-4	1767→1798
		-4	0,4	1762→1798
		4	-8	1762→1798
		4	-4	1763→1798
	R4BMB3	4	-8	1767→1797
	R4BMB4	-6	-4	1767→1797
		4	-4	1762→1798
		6	4	1767→1781
	R4BMB5	-6	-4	1767→1798
		0	-8	1767→1797
		6	0	1767→1797
	R4BMB6	6	0	1762→1798
	R4BMC1	0	4	1762→1798
	R4BMD3	-4,0,4	0	1745
SRB - PROTUBERANCES	R4BN53	-6	4	2346,2348,2351,2352,2301, 2359
	R4BN57	-6	4	2360
SRB - SURFACE	R4BS39	-6	-8	2042,2043,2044,2046
		-6	ALL	2041
		-6	-4	2043,2044,2046
		-6	0	2042
		-4	ALL	2043
		-4	-4,4	2044
		-4	-8,-4	2041,2042
		0	0,4	2042,2043,2044
		0,4	ALL	2041
		4	4	2043

TABLE V (Continued)

BAD PRESSURE DATA LIST
FIRST ENTRY

COMPONENT	IDENTIFIER	β	α	TAP NUMBER
SRB - SURFACE (Contd)	R4BS39	4	-4,0	2042,2044
		6	-8,4	2043,2044
		6	-8,0,4	2041,2042
		-6	ALL	2011,2024
EXTERNAL TANK - SURFACE	R4BT30	-6	-8,-4	1018→1020,1023→1025 1219→1221,1228→1230 1233→1235,1248→1250 1223,1224,1237→1240, 1252→1254
		-6	-8	1021,1022,1209,1213,1217, 1218,1222,1225,1227,1231, 1232,1236,1246,1247
		-6	-4	1022,1217,1218,1222,1225, 1227,1232,1236,1241,1243, 1251
		-4	-4	1230
		-4	-8	1021,1230,1246
	R4BT31	-6	-8	1018→1024,1209,1210,1212, 1213,1217→1254
		-6	-4	1020,1227
		0	4	1018→1021,1025,1218,1219, 1225,1227,1231→1233,1236, 1237,1243,1246,1247,1252
	R4BT32	-6	-4	1020,1021,1023,1024,1231, 1245,1253
		-6	4	1022,1236→1238,1246,1252, 1253
		-4	4	1244
	R4BT39	-6	-8	1054,1071→1073,1074,1085→ 1087,1089,1091,1092,1380, 1387,1516→1518,1523→ 1525,1527→1529,1536
		-6	-4	1059,1076,1071,1387,1518, 1522,1523,1524,1527→1529, 1535,1536
		-6	4	1056→1059,1078,1080,1098, 1099,1366,1367,1371→1373, 1387→1390,1392→1398,1400→ 1402,1413→1415,1417→1420, 1422,1423,1554→1559,1560, 1562,1564,1568→1573

TABLE V (Continued)

BAD PRESSURE DATA LIST
FIRST ENTRY

COMPONENT	IDENTIFIER	β	α	TAP NUMBER
EXTERNAL TANK - SURFACE (Contd)	R4BT39	-6	0	1425
		-4	0	1078→1082,1084,1504,1551→1553,1555,1557,1560→1567,1574
		-4	-4	1062→1065,1067→1069,1091,1400→1425,1501→1529
		-4	-8	1088,1144,1353→1355,1404,1409,1411,1412,1422,1424,1425,1512,1514,1515,1526,1528,1529
		0	0	1064,1065,1142,1143,1387→1389,1400→1402,1404→1407,1409→1411,1413→1415,1417→1420,1422→1424,1501→1503,1507→1509,1512→1514,1516→1519,1521→1523
		0	4	1062→1064,1066→1069,1078,1080→1085,1402,1403,1406→1412,1415,1416,1419→1425,1504,1505,1508→1515,1518,1519,1522→1529,1560→1562,1564
		0	-8	1064,1066,1068,1070,1073,1075,1077,1078,1080→1084,1382,1395,1408,1407,1416,1417,1420,1421→1425,1519,1520,1525→1529,1530→1534,1538,1541→1545,1546→1548,1555→1559,1560→1567,1569→1573,1574
		0	-4	1074→1077,1088→1090,1524,1530→1534,1542,1543
		4	-8	1070→1073,1074,1075,1077,1079,1082→1087,1091,1367,1368,1373,1387,1392,1526→1529,1535→1545,1546→1573
		4	4	1063,1078,1081,1082,1147,1405→1407,1409,1414,1517,1540,1552,1553,1554,1560,1561,1568,1570,1572,1573

TABLE V (Continued)

BAD PRESSURE DATA LIST
FIRST ENTRY

COMPONENT	IDENTIFIER	β	α	TAP NUMBER
EXTERNAL TANK - SURFACE (Contd)	R4BT39	4	0	1062,1065→1069,1077,1079→1081,1084→1087,1088→1090,1092,1093→1095,1144,1147→1149,1413→1425,1501→1510,1512→1515,1530→1539,1542→1525,1546→1553,1556→1559,1560→1567,1570→1573
		6	-8	1063→1066,1068,1069,1077→1080,1082,1083,1085,1087,1088,1089,1091→1094,1143,1402,1406→1409,1412,1413,1414,1417,1421,1507,1509,1512→1515,1516,1518,1521,1523,1526→1529,1537,1539→1545,1551,1553→1559,1560,1561,1567,1570→1573
		6	-4	1064,1417
		6	0	1062,1409,1410,1412,1420,1526,1527
		6	4	1054→1059,1060→1101,1364→1373,1374→1425,1501→1573
	R4BT57	-6	4	1102,1104,1107,1108,1114,1116,1127,1141,1546,1547,1556,1558,1559,1560,1561,1566→1569
	R4BT63	0	-8	1040,1041
	R4BT99	±4,±6	-8	1182,1183
	R4BTA7	6	-4	1402→1405,1408→1411,1416,1417,1419,1421→1424,1516→1520,1523→1527
	R4BTA9	-8	-4	1182,1183
		0	-8	1182,1183
		4	-4	1182,1183
	R4BTB6	6	0	1408,1409,1421,1422,1516→1527
	R4BTE3	6	-6	1184→1186,1189,1195,1196,1200,1202,1208,1209,1217,1218,1222,1223,1224,1226,1232,1236→1242,1247,1251→1254,1205,1206

TABLE V (Continued)

BAD PRESSURE DATA LIST
FIRST ENTRY

COMPONENT	IDENTIFIER	β	α	TAP NUMBER
WING - UPPER SURFACE	R4BU28	8	8	818→833
		-8	4	↓
		-6	-8	↓
	R4BU29	4	-8,-4,4	↓
	R4BU30	-6	-4	↓
		-4	-8,-4	↓
		4,6	-8	↓
	R4BU32	-4	4	↓
	R4BU33	0	-4	↓
		4	4	↓
		6	0	↓
	R4BU34	-6	-4	↓
		-4	4,0	↓
	R4BU35	-6	0	↓
		-4,6	4	↓
		0	-8,0	↓
		4	-8	↓
	R4BU36	-6	-8,-4,0	↓
		0,4	4	↓
	R4BU37	-4	-4,-8	↓
		4	-8,0,4	↓
	R4BU38	-6	-4	↓
		-4	0,-8	↓
		0	4	↓
		4	-4,0,4	↓
		6	-4	↓
	R4BU39	-6	-8,0	↓
		-4	-8,4	↓
		0	-4,0	↓
		4	-4,4	↓
		6	-8,0	818→833
	R4BU40	6	0,4	693
	R4BU41	ALL	ALL	693
	R4BU42	ALL	ALL	693
	R4BU30 → R4BU46	ALL	ALL	861
	R4BU47	-6	-8	693
	R4BU47 → R4BU49	ALL	ALL	861
	R4BU47	0	ALL	693
	R4BU48	ALL	ALL	693
	R4BU50	-8	ALL	693

TABLE V (Continued)

BAD PRESSURE DATA LIST
FIRST ENTRY

COMPONENT	IDENTIFIER	β	α	TAP NUMBER
WING - UPPER SURFACE (Contd)	R4BU51	ALL	ALL	693
	R4BU54	ALL	ALL	693,861
	R4BU55 →R4BU57	ALL	ALL	861
	R4BU62	-6,0	ALL	693
	R4BU62	ALL	ALL	861
	R4BU63	ALL	ALL	861
	R4BU65 →R4BU67	ALL	ALL	827,828
	R4BU66 →R4BU71	ALL	ALL	861
	R4BU64 →R4BU69	ALL	ALL	796
	R4BU72 →R4BU75	ALL	ALL	796
	R4BU74 →R4BU97	ALL	ALL	861
	R4BU81	-6	-8,-4	796
		-6	-4	887
		-6	0,4	796,887
		0	-8,-4	796,887
		6	ALL	796
		6	-8,-4,4	887
	R4BU83 →R4BU87	ALL	ALL	796
	R4BU83 →R4BU97	ALL	ALL	858,887,888
	R4BU99	ALL	ALL	693
		-4	6	861
		ALL	ALL	795→797
		ALL	ALL	828,829
		ALL	ALL	856→858
		ALL	ALL	886→888
	R4BU52 →R4BU53	ALL	ALL	861
	R4BU58 →R4BU61	ALL	ALL	861
	R4BU60 R4BU61	ALL	ALL	693
	R4BUA1 →R4BUE3	ALL	ALL	795,796,826,828,829, 856→858,885→888,706,861

TABLE V. (Continued)

BAD PRESSURE DATA LIST
FIRST ENTRY

COMPONENT	IDENTIFIER	β	α	TAP NUMBER
VERTICAL TAIL	R4BV28 → R4BV67	ALL	ALL	501,502,542
	R4BV29	-6	ALL	516
	R4BV41 → R4BV67	ALL	ALL	560
	R4BV58	-6,0	-8	501→507,509→524
		-6	0	↓
		6	-4,4	↓
		0	4	↓
		4	0	↓

TABLE V (Continued)

BAD PRESSURE DATA LIST
SECOND ENTRY

COMPONENT	DATA SET IDENTIFIER	β	α	TAP NUMBER
ORBITER FUSELAGE	R4FB12	6	0	167→173,178→182,185,187→192, 199→203,205→207,209→213,217
ORBITER BASE	R4FE06	0	0	305
	R4FE10	6	-8	305,307,320
	R4FE11	4	-8	304,305,309,310,314,315, 319,320,324
		4	-6	304,305,307,310,314,315,319, 320,324
		4	-4	302,307,308,309,310,311,312, 314,315,316,317,319→322,324
	R4FE33,34	ALL	ALL	308
	R4FE59→64	ALL	ALL	308
	R4FE73	-6	4	303,306,310,313,314,315,319, 320,323
		-4	4	305,307,310
	R4FE74	6	-8,-4	305,307,320,324
		-6	4	304,305,306,309,310,315,319, 320,323,324
	R4FE75	ALL	-8,-4	308
		ALL	0	308
	R4FE82	-6	4	304,305,309,310,314,315,319, 320,324
	ALL	ALL	ALL	301
BODY FLAP - LOWER SURFACE	R4FF06	0	0	436
	R4FF10	6	-8	411
	R4FF11	4	-8	401,410,411,426,436
		4	-6	401,410,411,420,425,426,435
		4	-4	ALL
	R4FF73	-6	4	404,409,410,411,426,436
		-3	4	411
	R4FF74	6	-8	402,411

TABLE V (Continued)

BAD PRESSURE DATA LIST
SECOND ENTRY

COMPONENT	DATA SET IDENTIFIER	β	α	TAP NUMBER
BODY FLAP - LOWER SURFACE (contd)	R4FF74	4	-4	436
		6	-4	402
		-6	4	410,411,420,425,426,435,436
	R4FF82	-4	4	401,410,411,420,425,426,435, 436
BODY FLAP - UPPER SURFACE	R4FG03	ALL	ALL	414
	R4FG06	ALL	ALL	414
		0	0	406,421,440
	R4FG10	6	-8	406,416
	R4FG11	4	-8	415,416,421,431,440
		4	-6	405,406,415,421,430,440
		4	-4	ALL
	R4FG25 →R4FG30	ALL	ALL	414
	R4FG53 →R4FG58	ALL	ALL	414
	R4FG73	-6	4	405→408,414→416,421,424,431, 440
		-4	4	406,416
	R4FG74	6	-8	406,408,416
		4	-4	421
		6	-4	406
		-6	4	405→408,415,416,421,430,431, 432,440
	R4FG82	-4	4	405,406,415,416,430,431,440
	R4FG95 →R4FG97	ALL	ALL	414
MISCELLANEOUS	R4FJ11	4	-8	215
	R4FJ74	4	-4	583

TABLE V (Continued)

BAD PRESSURE DATA LIST
SECOND ENTRY

COMPONENT	DATA SET IDENTIFIER	β	α	TAP NUMBER
WING - LOWER SURFACE	ALL	ALL	ALL	809
	R4FL08	ALL	ALL	650
	R4FL12	6	0	ALL
	R4FL65	ALL	-8,-4	814
	R4FL66 →R4FL74	ALL	ALL	814
	R4FL66	ALL	-8	872,900,902
		ALL	6	810,812
	R4FL67 →R4FL74	ALL	ALL	812
	R4FL73	-6	4	808,809
		-4	4	810
	R4FL74	ALL	-8	809
		6	-8	810
		ALL	-4,0	810
		-6	4	808
SRB PROTUBERANCES	ALL	ALL	ALL	2306→2312,2314,2335→2343
SRB SURFACE	R4FS06	0	0	2160
	R4FS11	4	-8	2210
		4	-6	2209,2210
		4	-4	2210
		6	0	ALL
	R4FS73	-6	4	2209,2210
	R4FS82	-4	4	2170,2171,2175,2204
EXTERNAL TANK SURFACE	R4FT06	0	0	1559
	R4FT11	4	-8	1425,1529
	R4FT12	6	0	1306→1309,1311,1312, 1323→1329,1340→1346, 1357→1362,1375→1380, 1391→1393,1395→1397, 1408→1414,1421,1425
		ALL	4	1351
	R4FT64	4	0	1517,
	R4FT66	ALL	6	1375,1351
	R4FT73	-6	4	1424,1425,1543,1544,1545

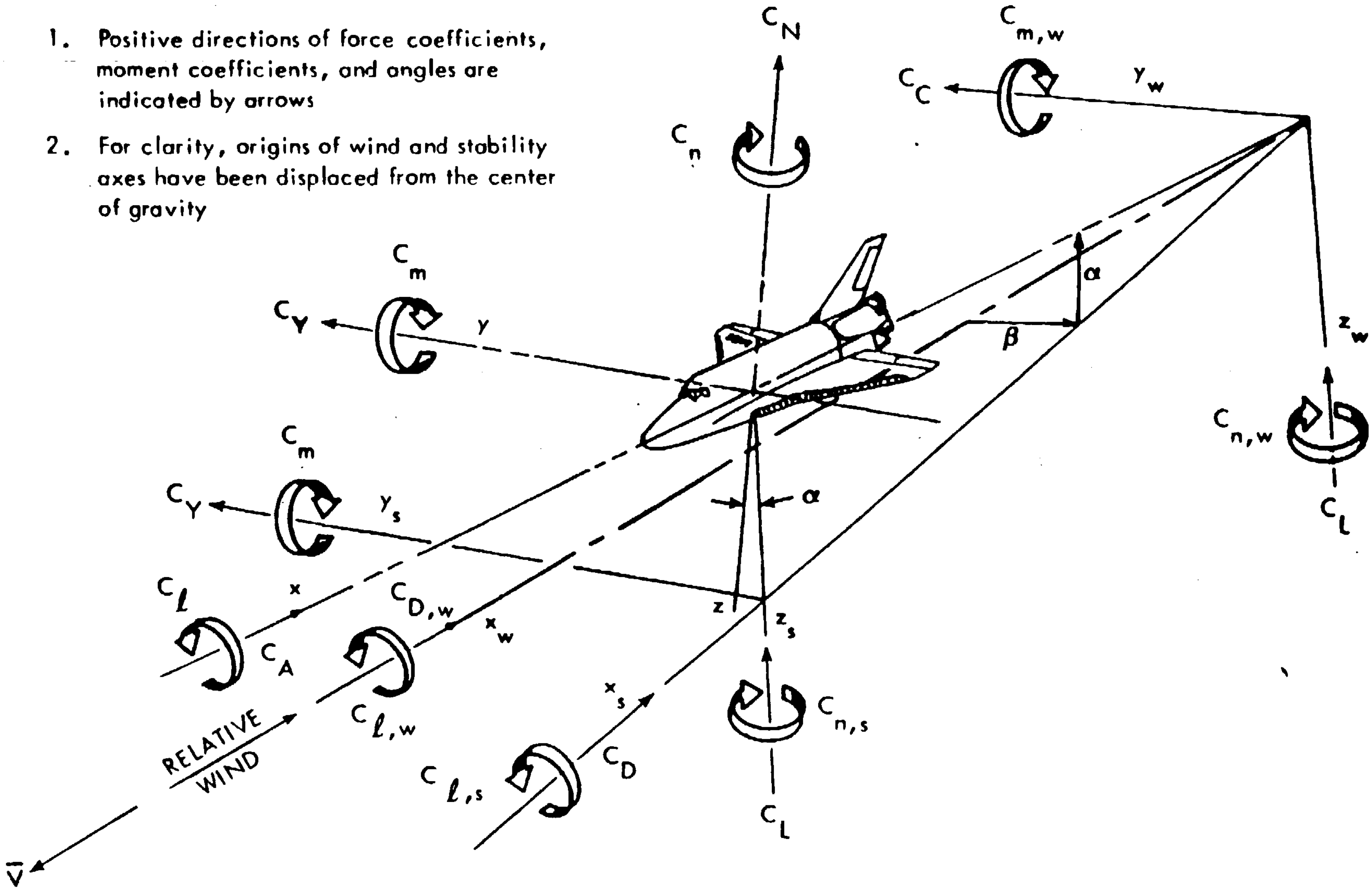
TABLE V (Concluded)

BAD PRESSURE DATA LIST
SECOND ENTRY

COMPONENT	DATA SET IDENTIFIER	β	α	TAP NUMBER
EXTERNAL TANK SURFACE (Contd)	R4FT73	-4	4	1425,1545
	R4FT74	4	-4	1425,1545
	R4FT75	-8	-8	1546
	R4FT82	-4	4	ALL
UPPER WING BASE	R4FU08	ALL	-8	796
	R4FU12	6	0	636,637,672,794,796→801, 819→824,358→862,879→884, 886,906
	R4FU66	-6→0	-8	796
	R4FU82	-4	4	770,802

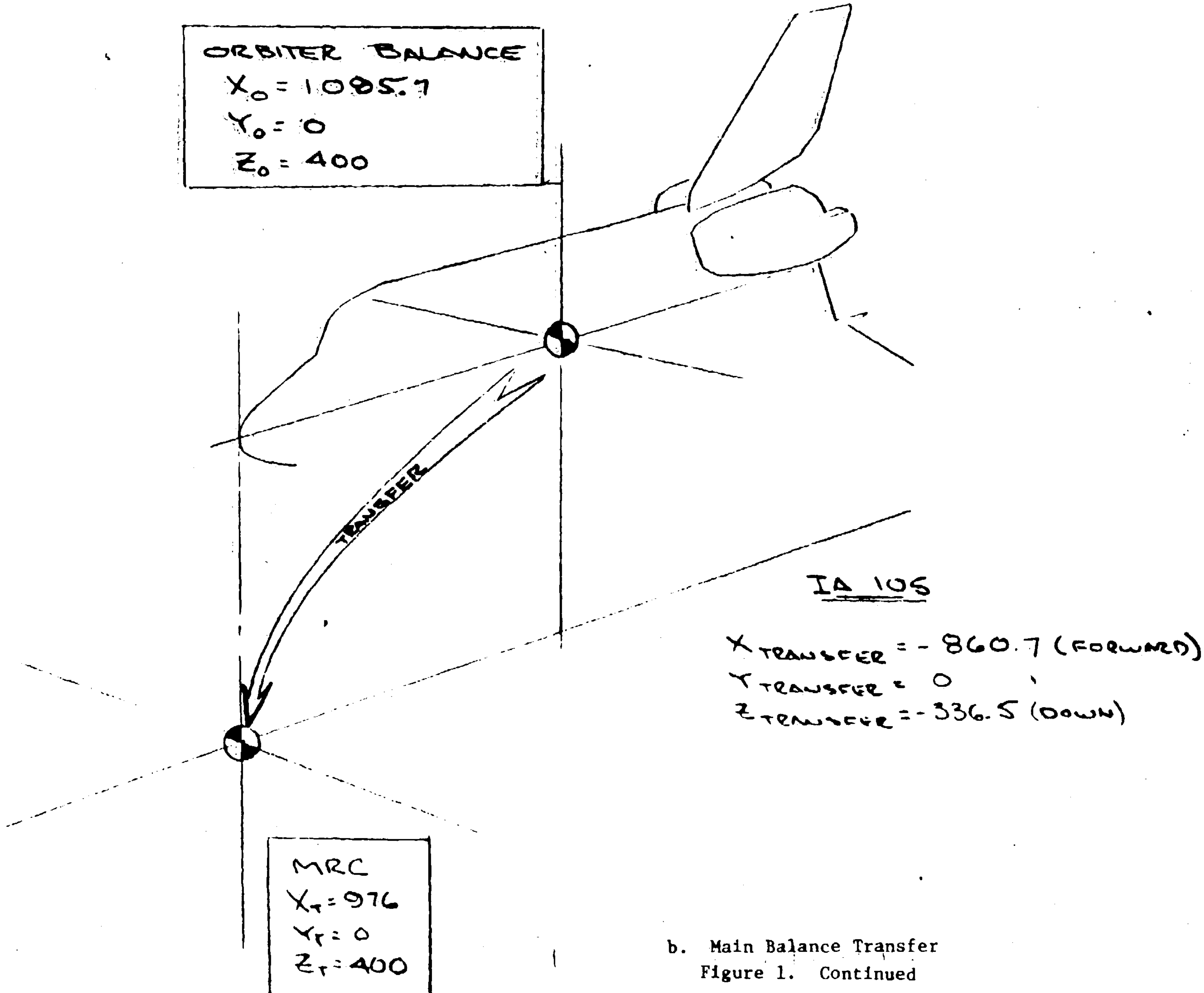
Notes:

1. Positive directions of force coefficients, moment coefficients, and angles are indicated by arrows
2. For clarity, origins of wind and stability axes have been displaced from the center of gravity

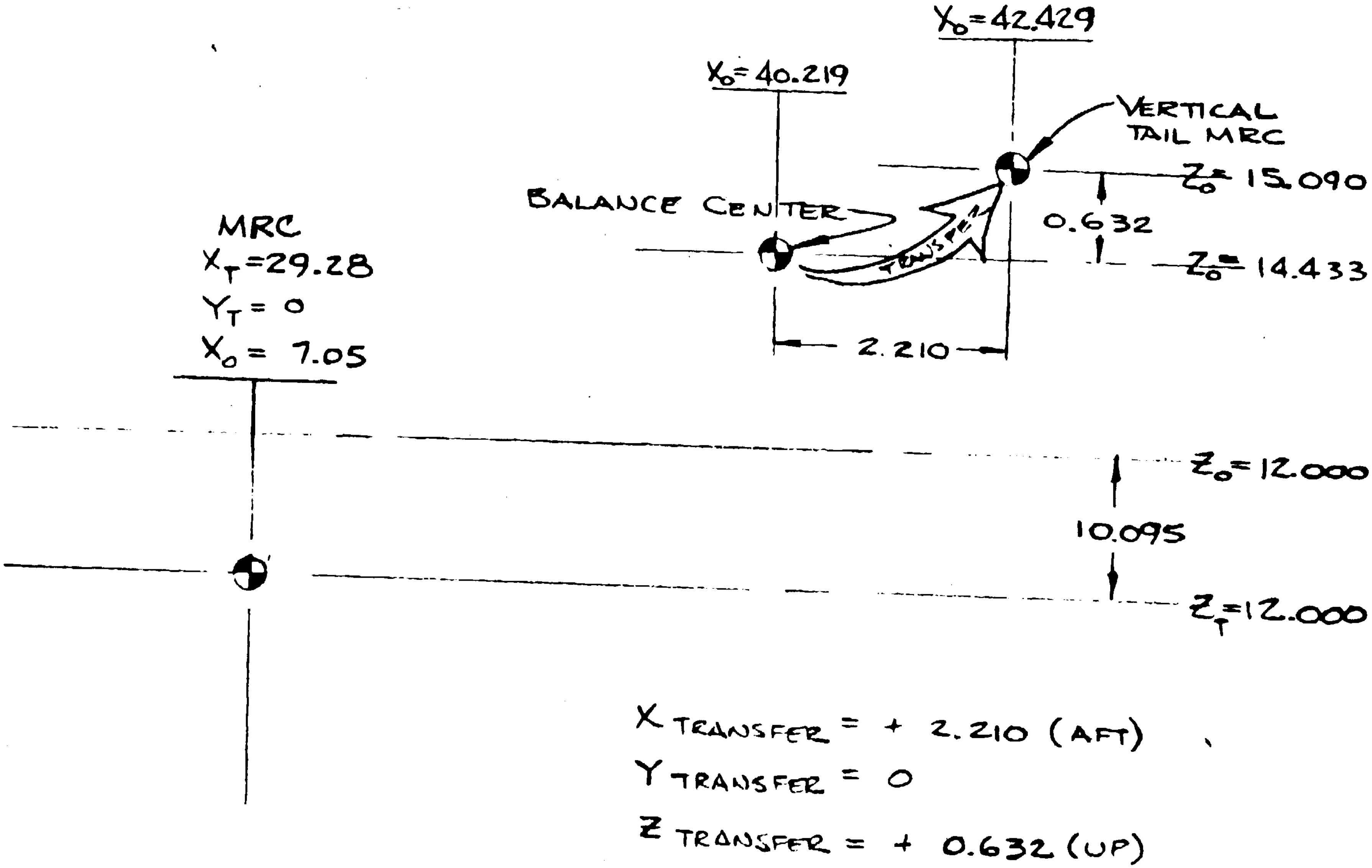


a. Axis Systems

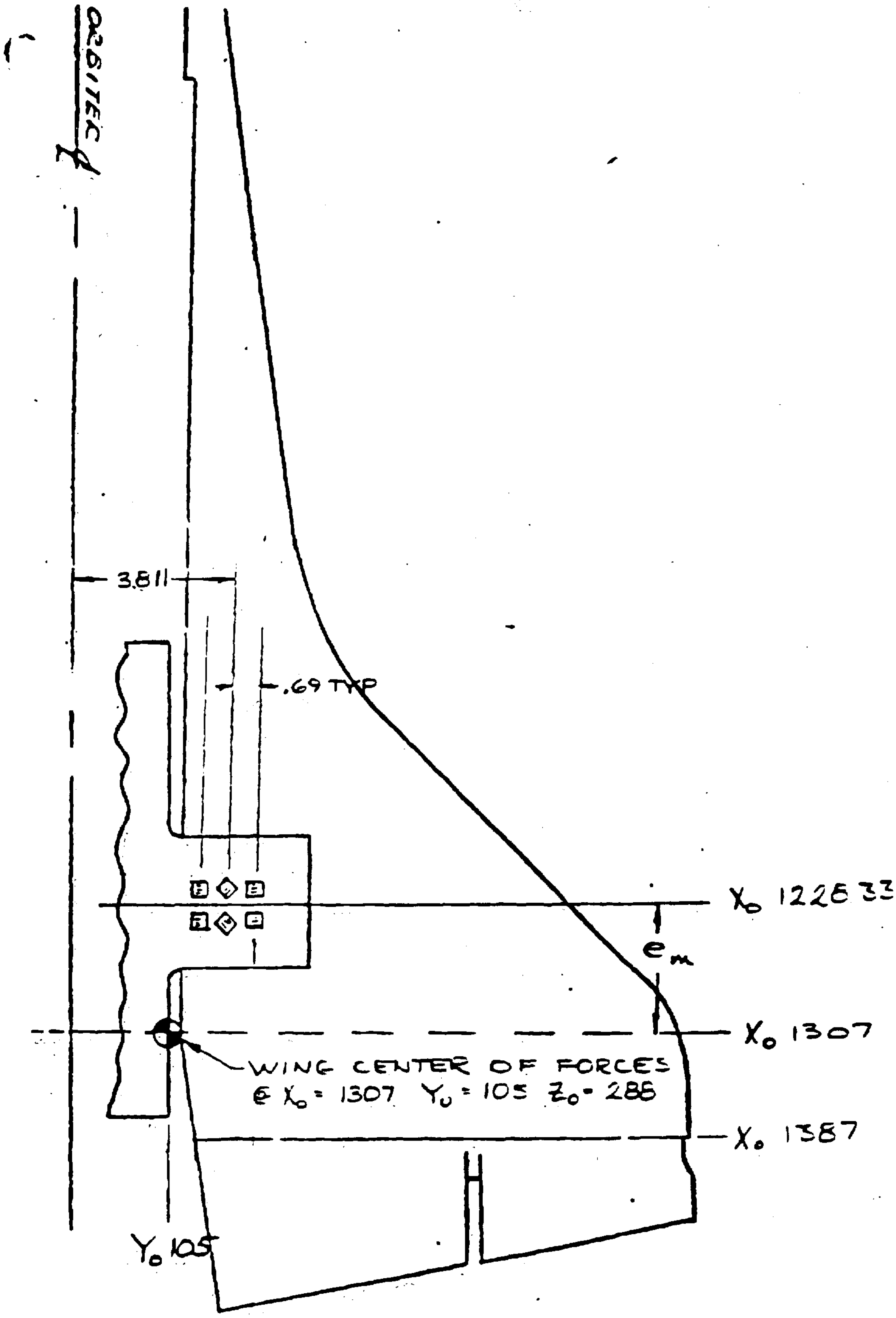
Figure 1. Model Axis Systems, Sign Conventions and Reference Dimensions



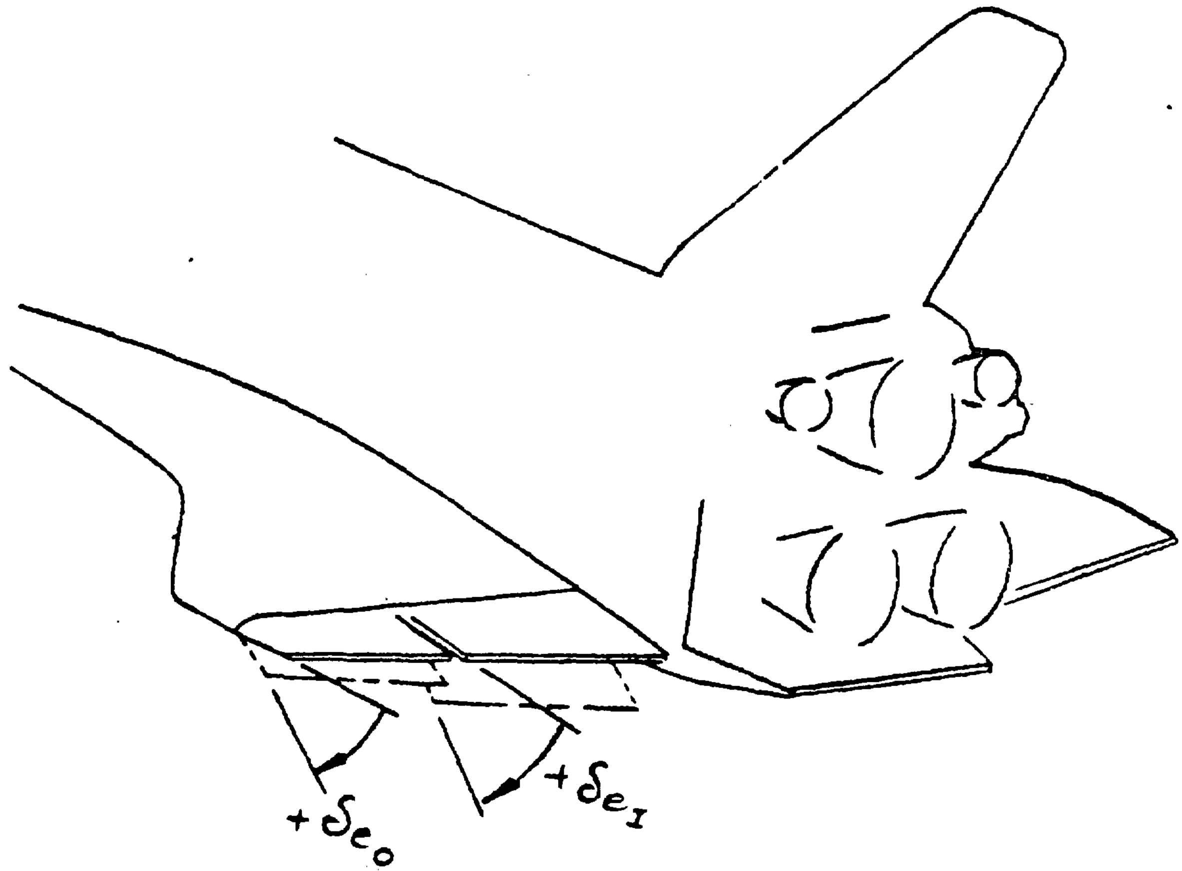
b. Main Balance Transfer
Figure 1. Continued



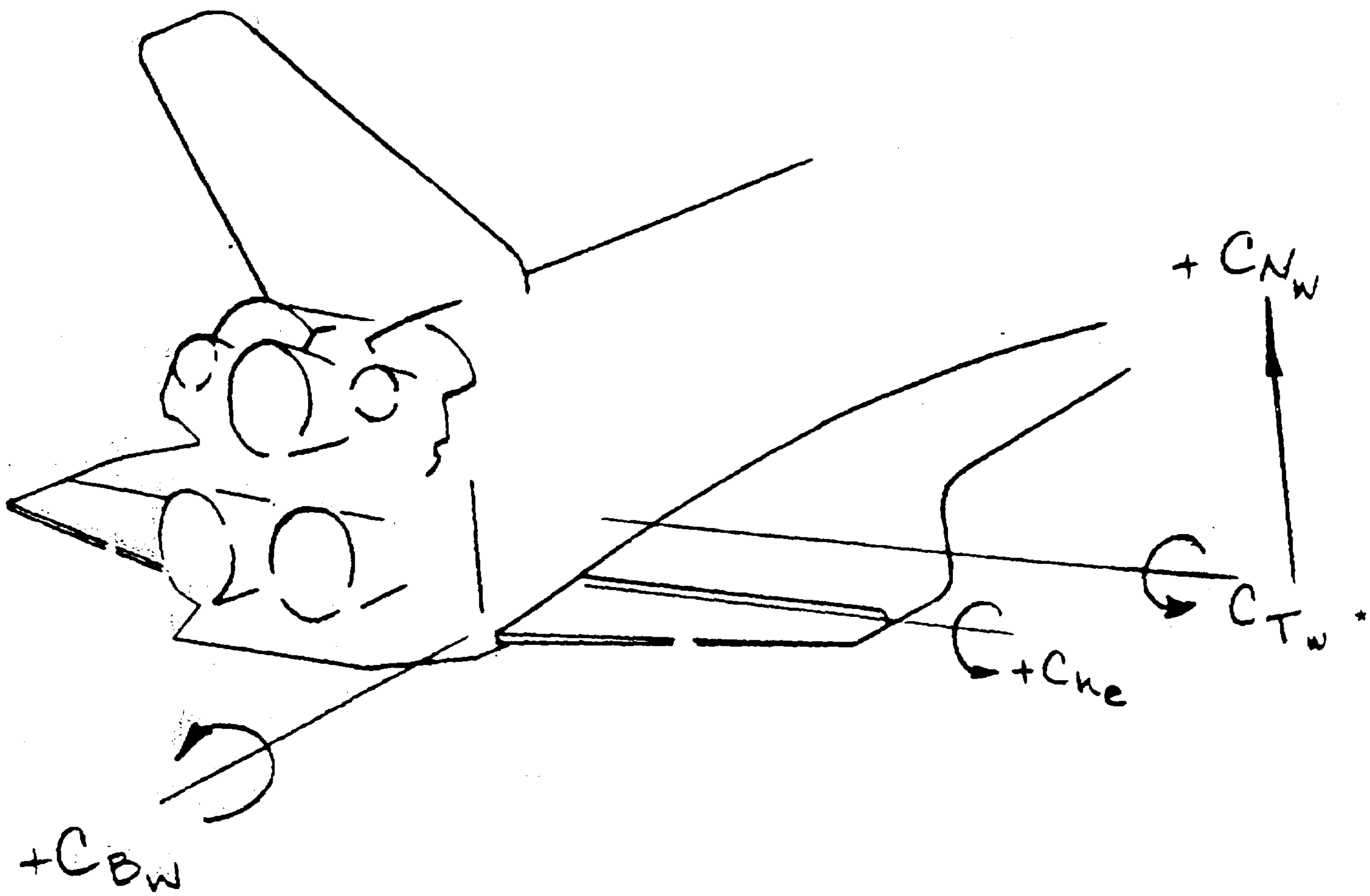
c. Vertical Tail Balance Transfer
Figure 1. (Continued)



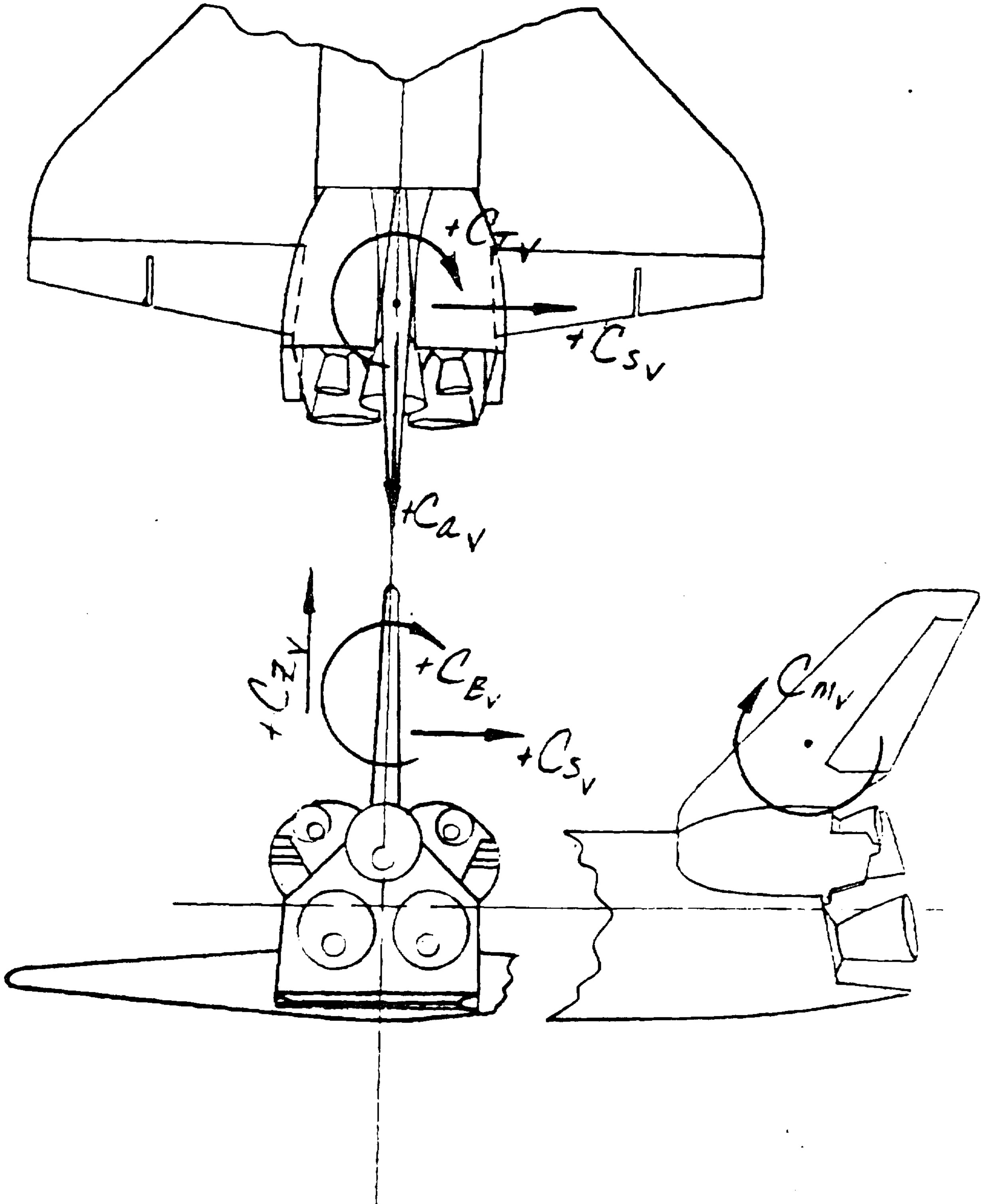
d. Wing Balance Transfer
Figure 1. (Continued)



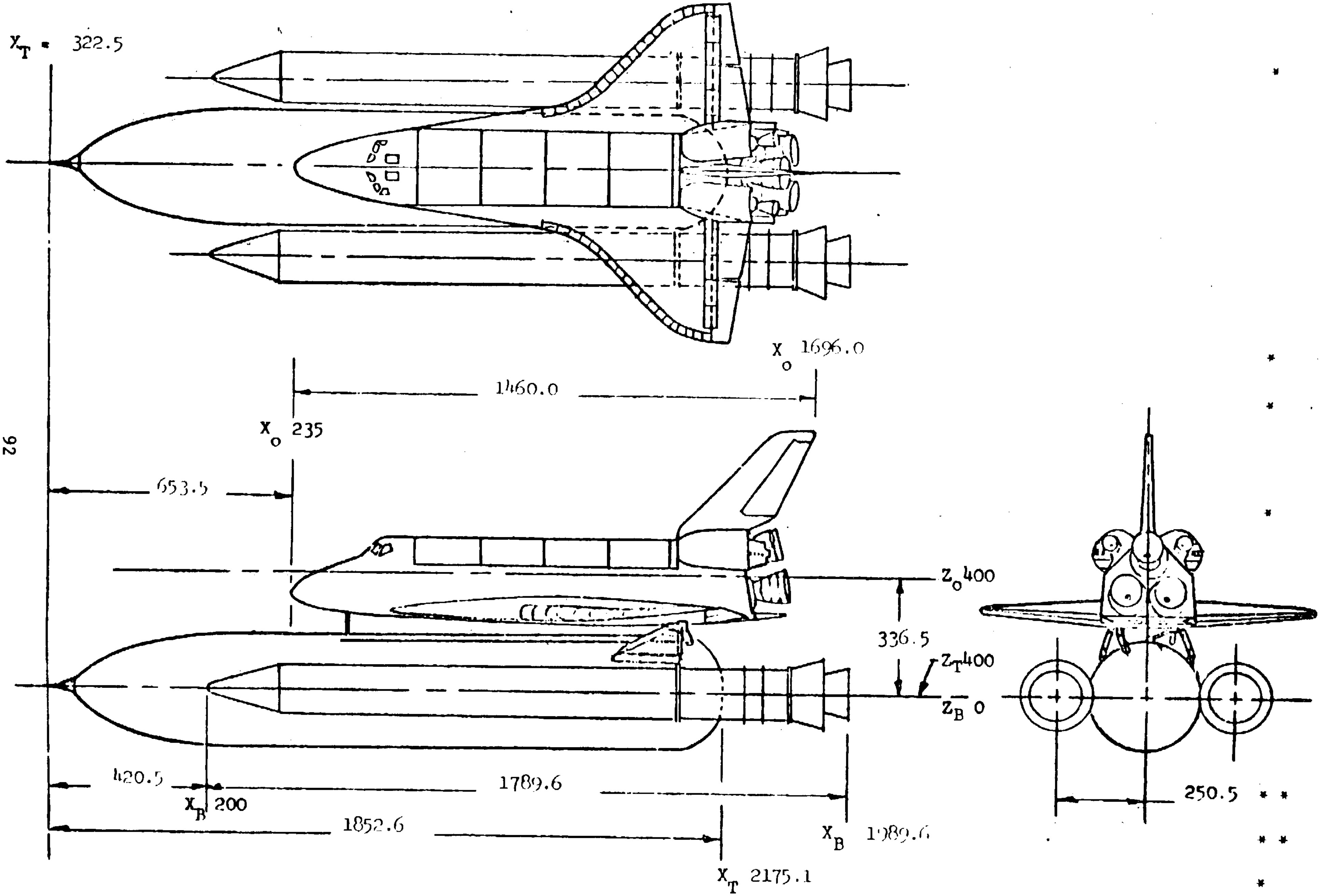
e. Elevon Deflection Sign Convention
Figure 1. (Continued)



f. Wing Load Sign Convention
Figure 1. (Continued)

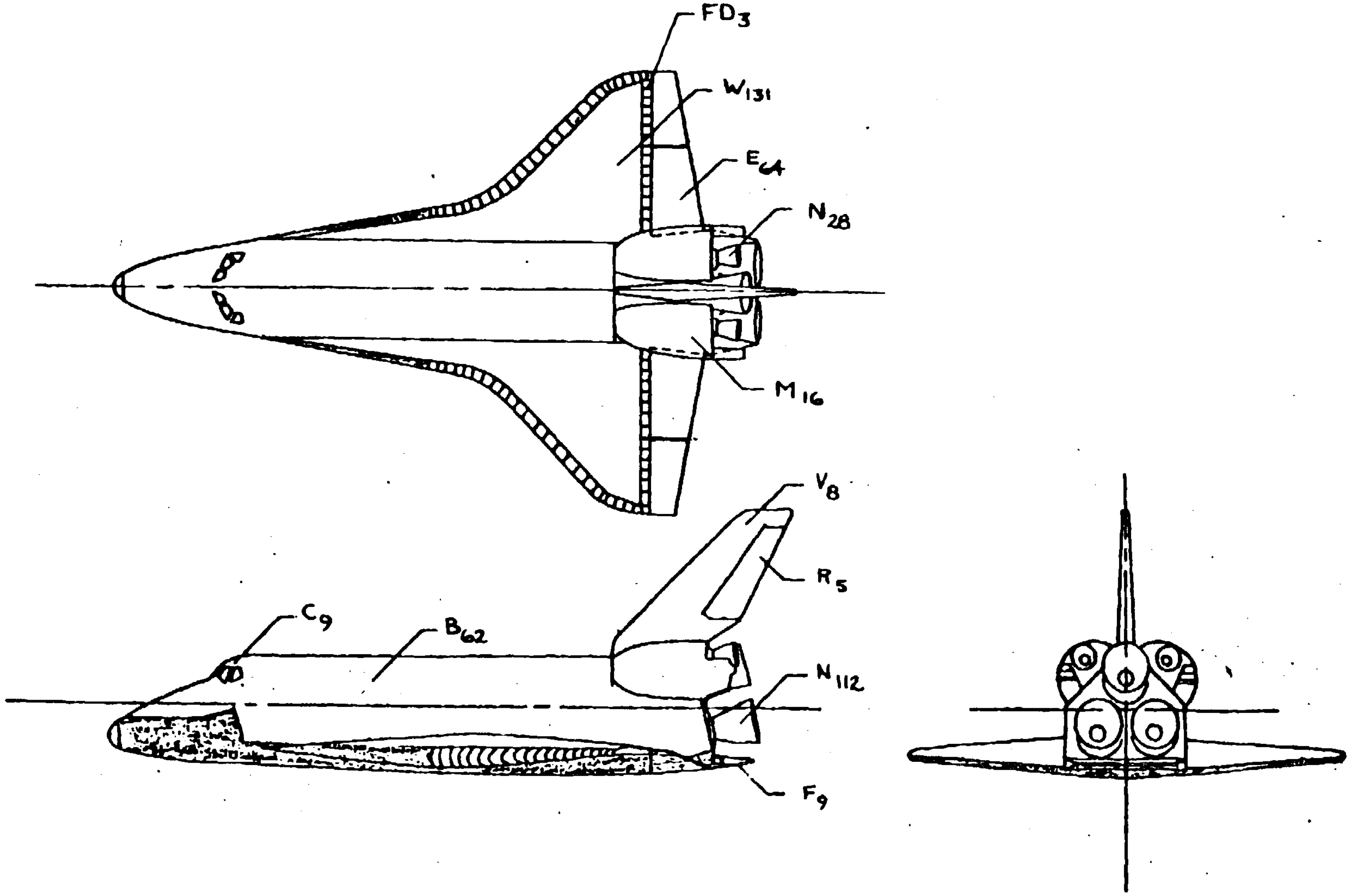


g. Vertical Tail Load Sign Convention
Figure 1. (Concluded)

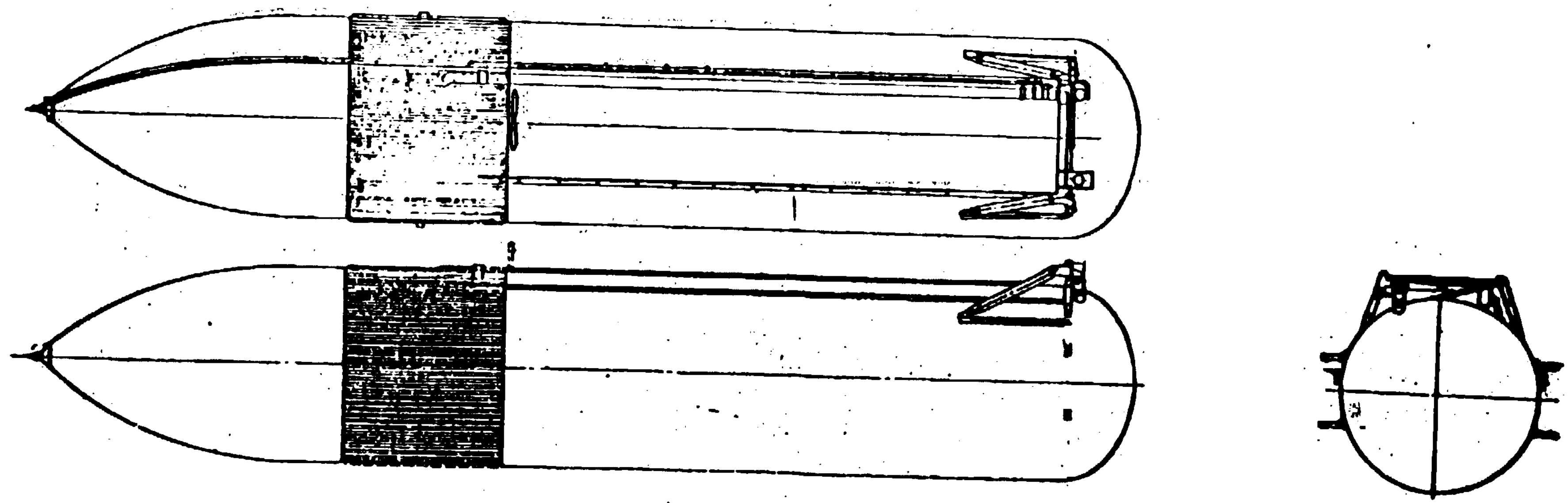


a. Launch Vehicle

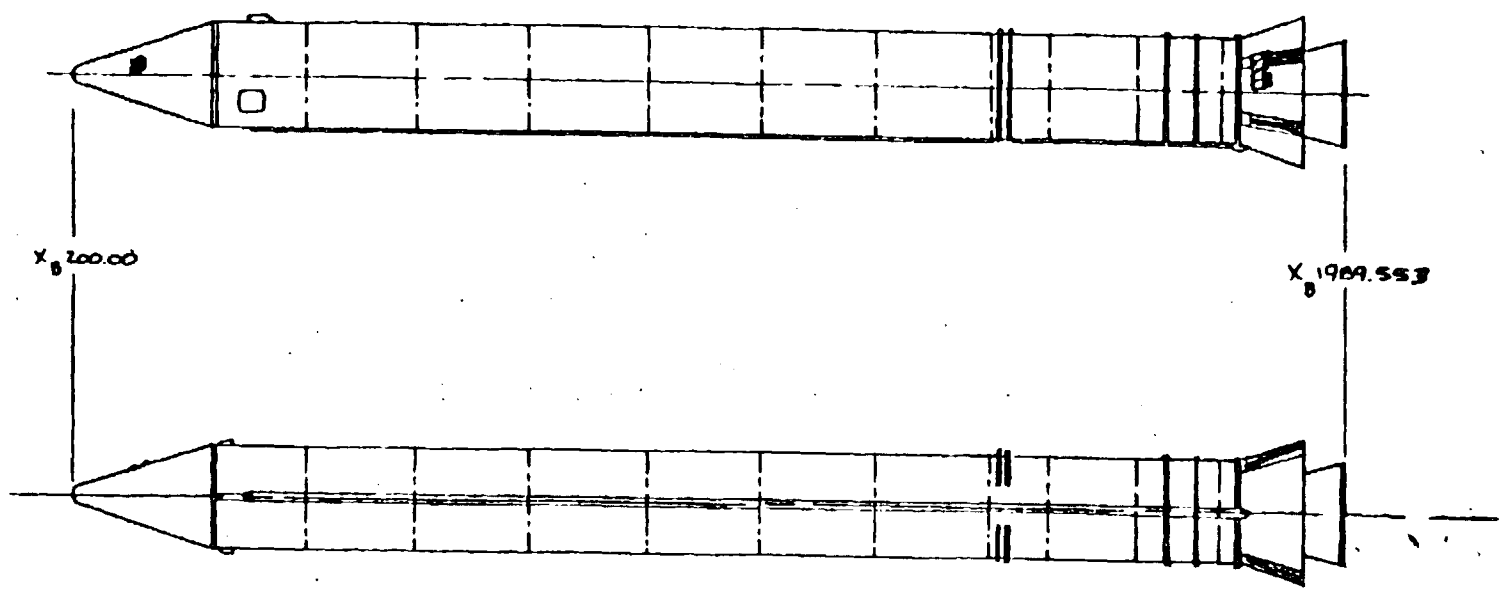
Figure 2. Launch Vehicle 6 Configuration



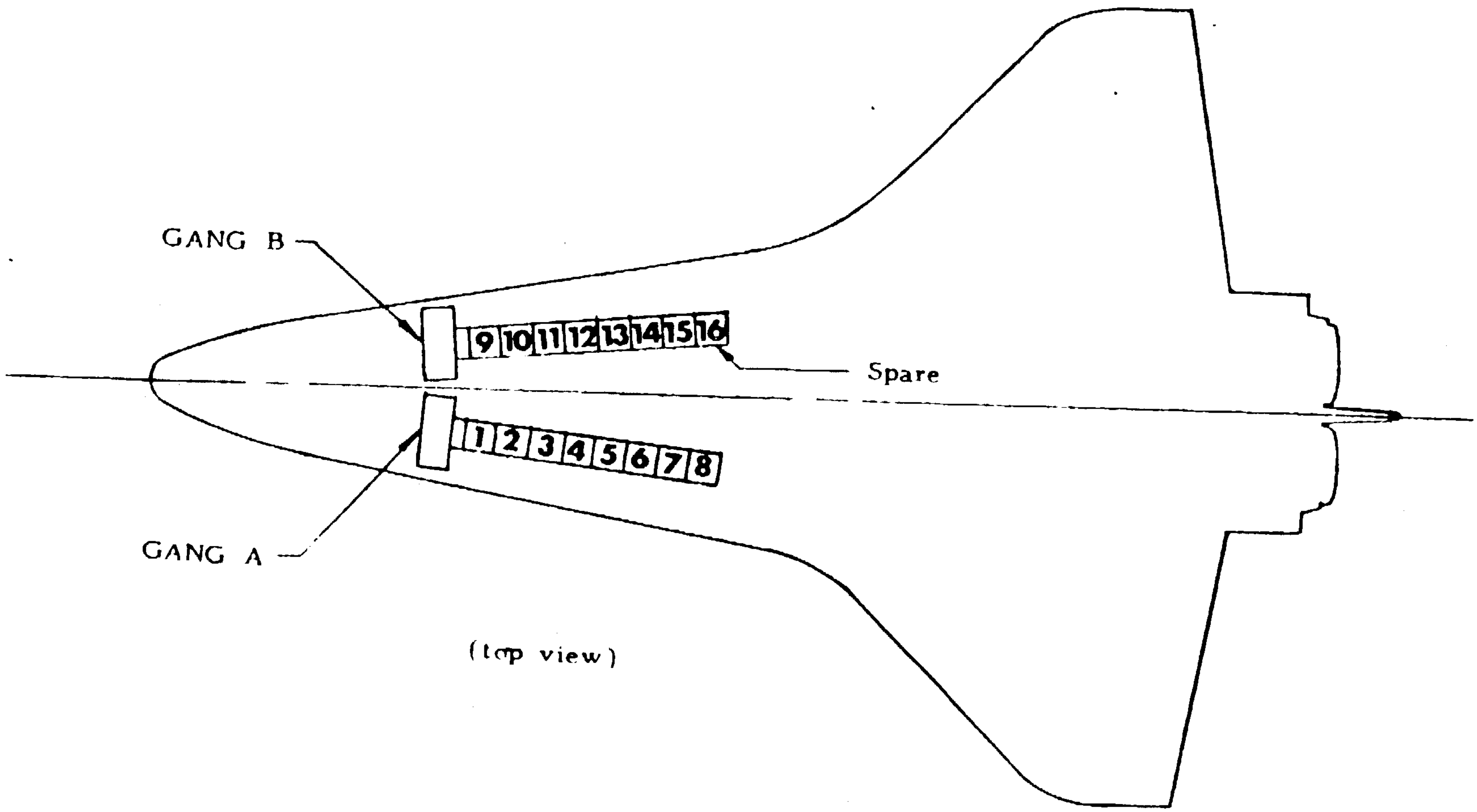
b. Orbiter 102
Figure 2. (Continued)



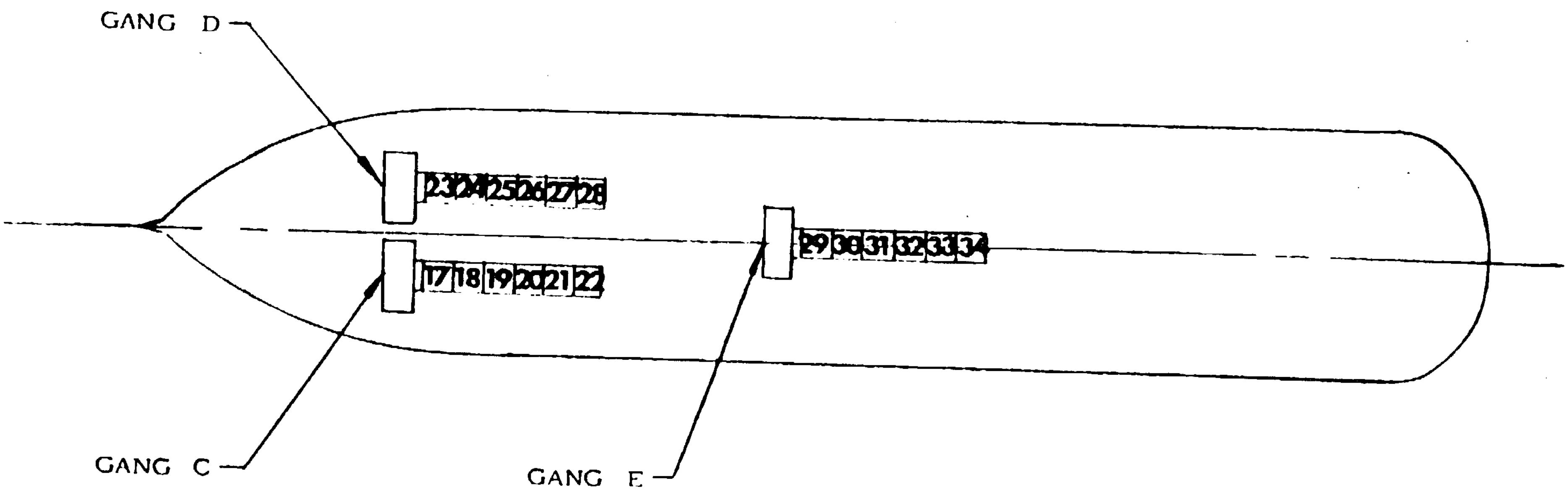
c. External Tank - T39
Figure 2. (Continued)



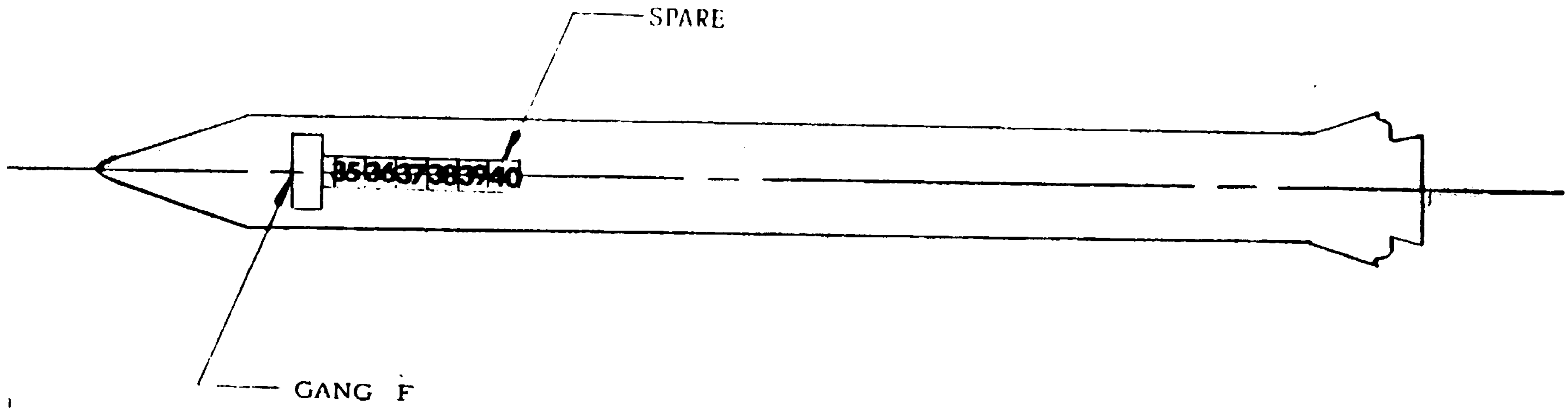
d. Solid Rocket Booster - S_{27}
Figure 2. (Concluded)



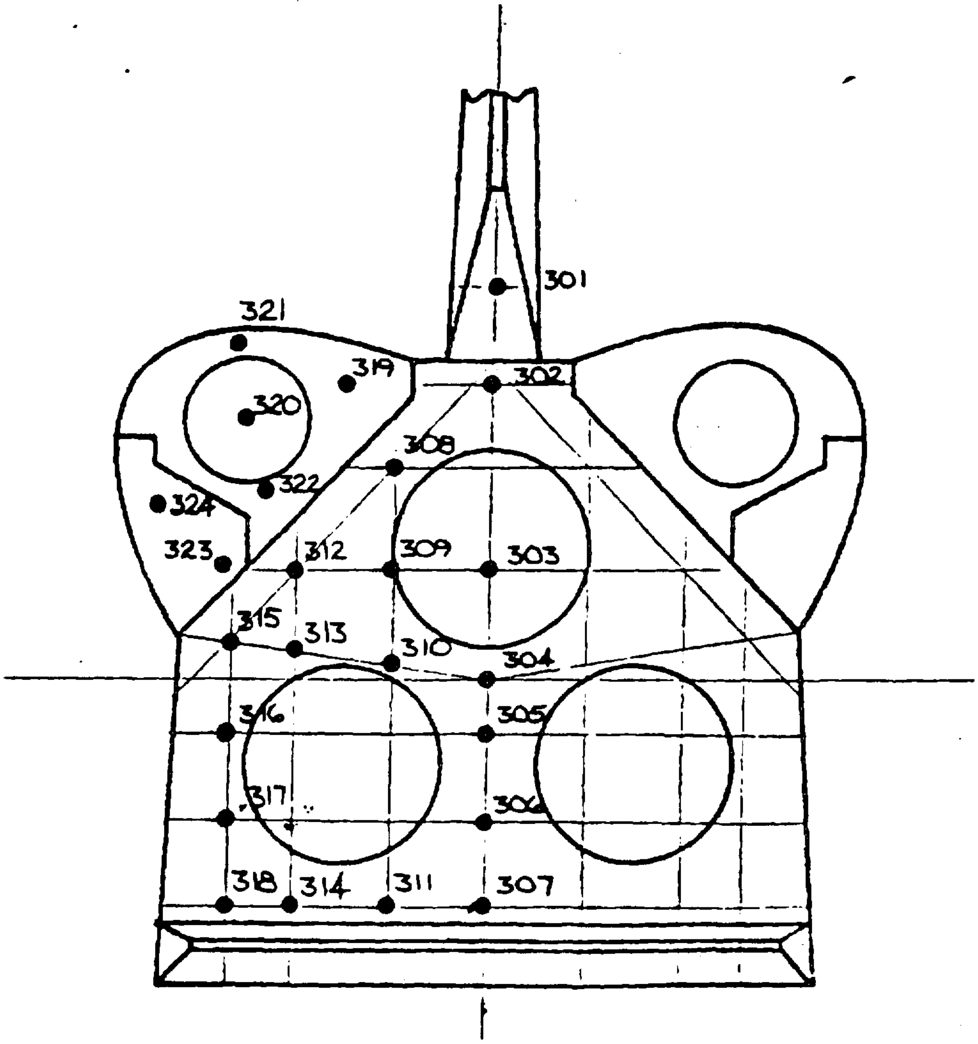
a. Orbiter
Figure 3. Scanivalve Locations



b. External Tank
Figure 3. (Continued)



c. Solid Rocket Booster
Figure 3. (Concluded)



TAP	Z_o	Y_o
301	532	0
302	505	0
303	443	0
304	400	0
305	376	0
306	340	0
307	302	0
308	478	-38

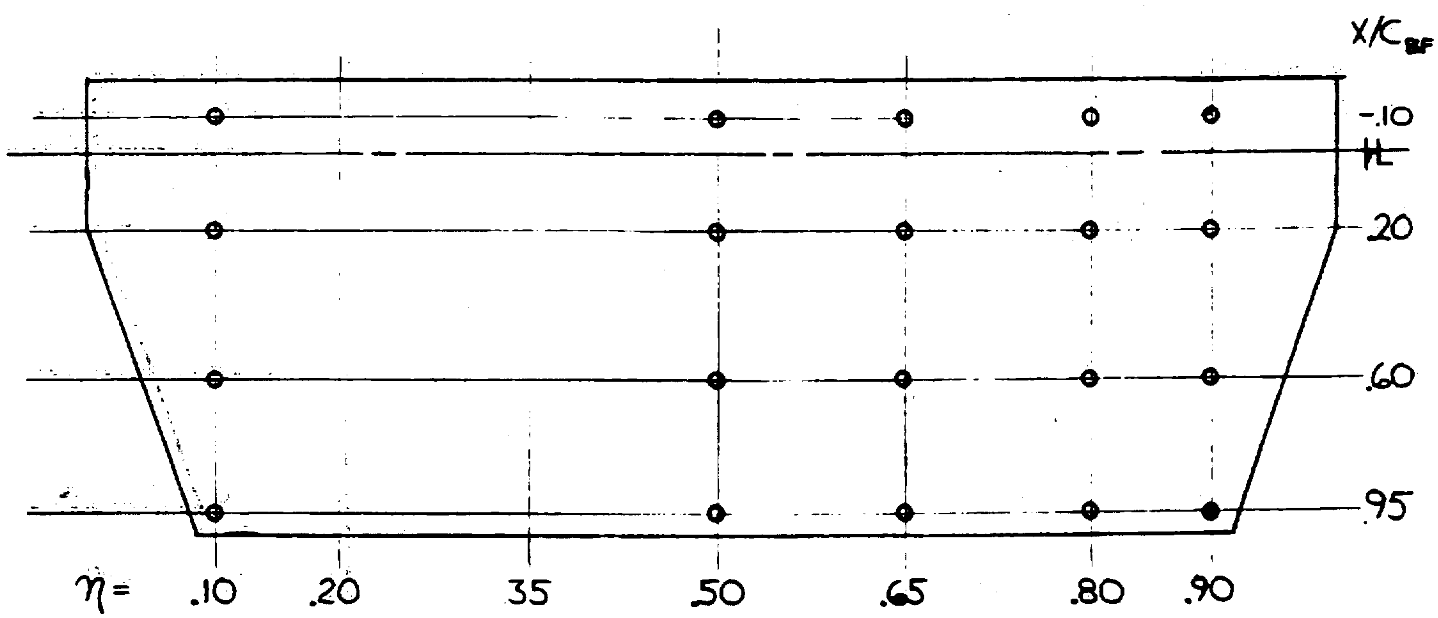
TAP	Z_o	Y_o
309	439	-38
310	405	-38
311	302	-38
312	439	-78
313	410	-78
314	302	-78
315	414	-103
316	376	-103

TAP	Z_o	Y_o
317	340	-103
318	302	-103
319	514	-55
320	492	-88
321	522	-103
322	470	-96
323	439	-107
324	465	-130

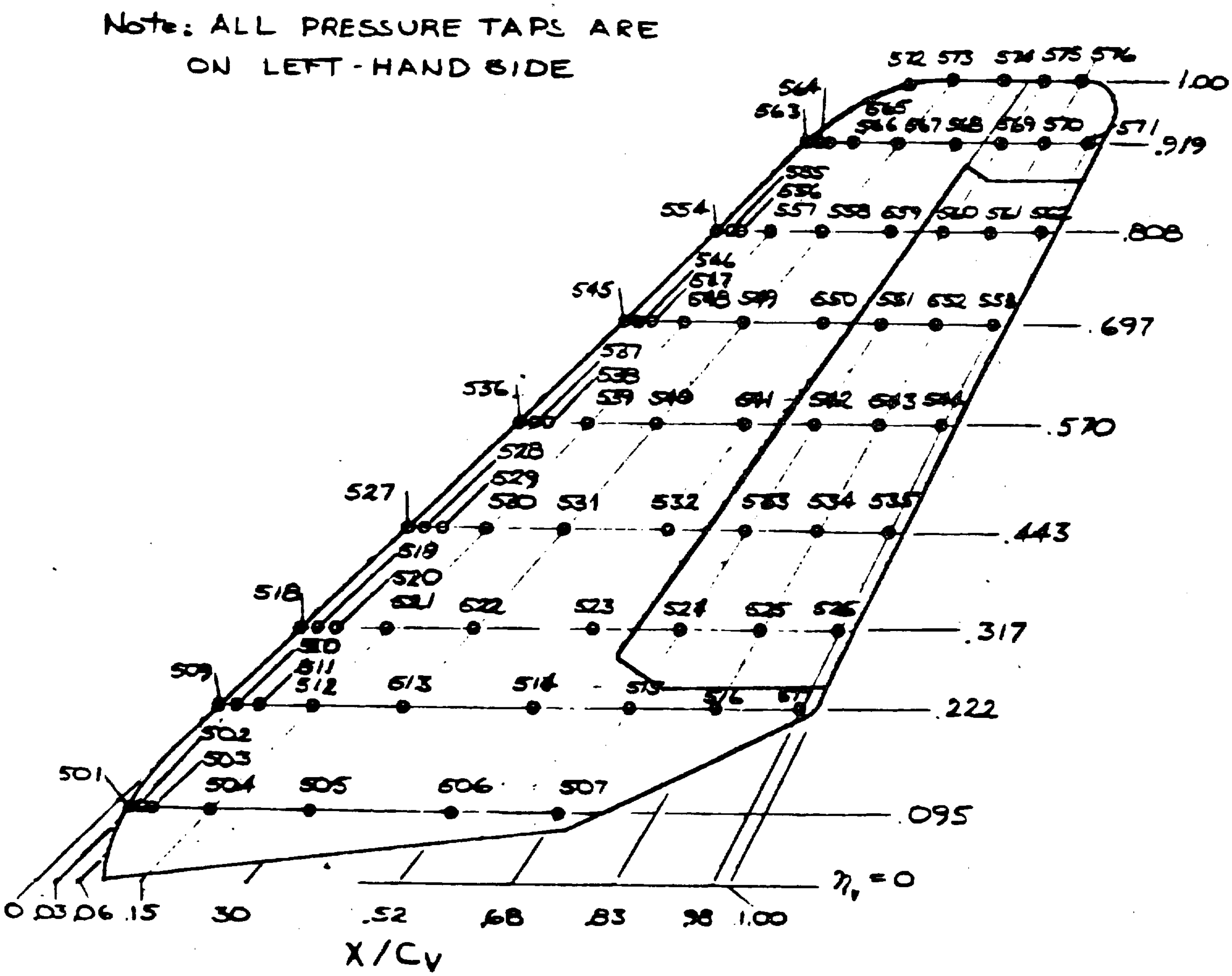
a. Orbiter Base

Figure 4. Orbiter Pressure Tap Locations

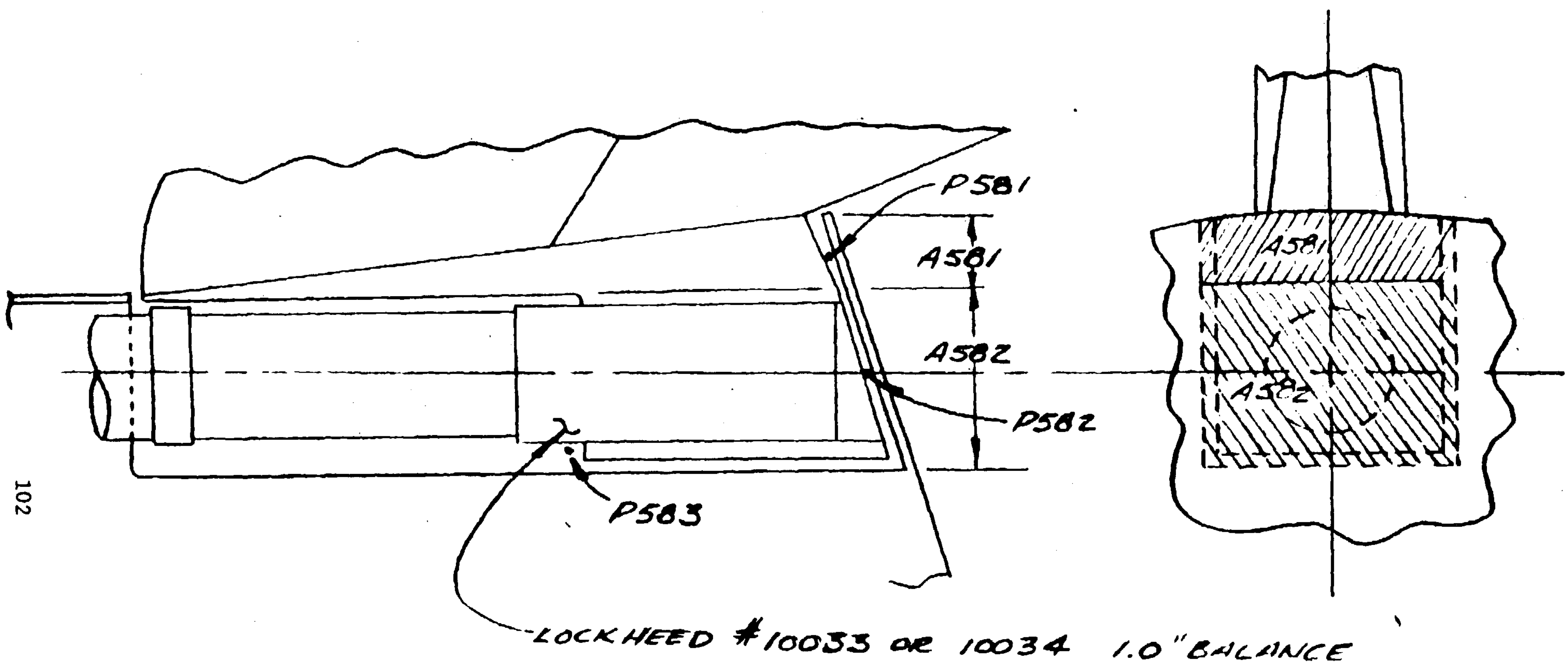
η	X/C_BF (BOTTOM)				X/C_BF (TOP)			
	-.10	.20	.60	.95	-.10	.20	.60	.95
.10	401	402	403	404	405	406	407	408
.50	409	410	411	412	413	414	415	416
.65	417	418	419	420	421	422	423	424
.80	425	426	427	428	429	430	431	432
.90	433	434	435	436	437	438	439	440



b. Body Flap
Figure 4. (Continued)



c. Vertical Tail
Figure 4. (Continued)



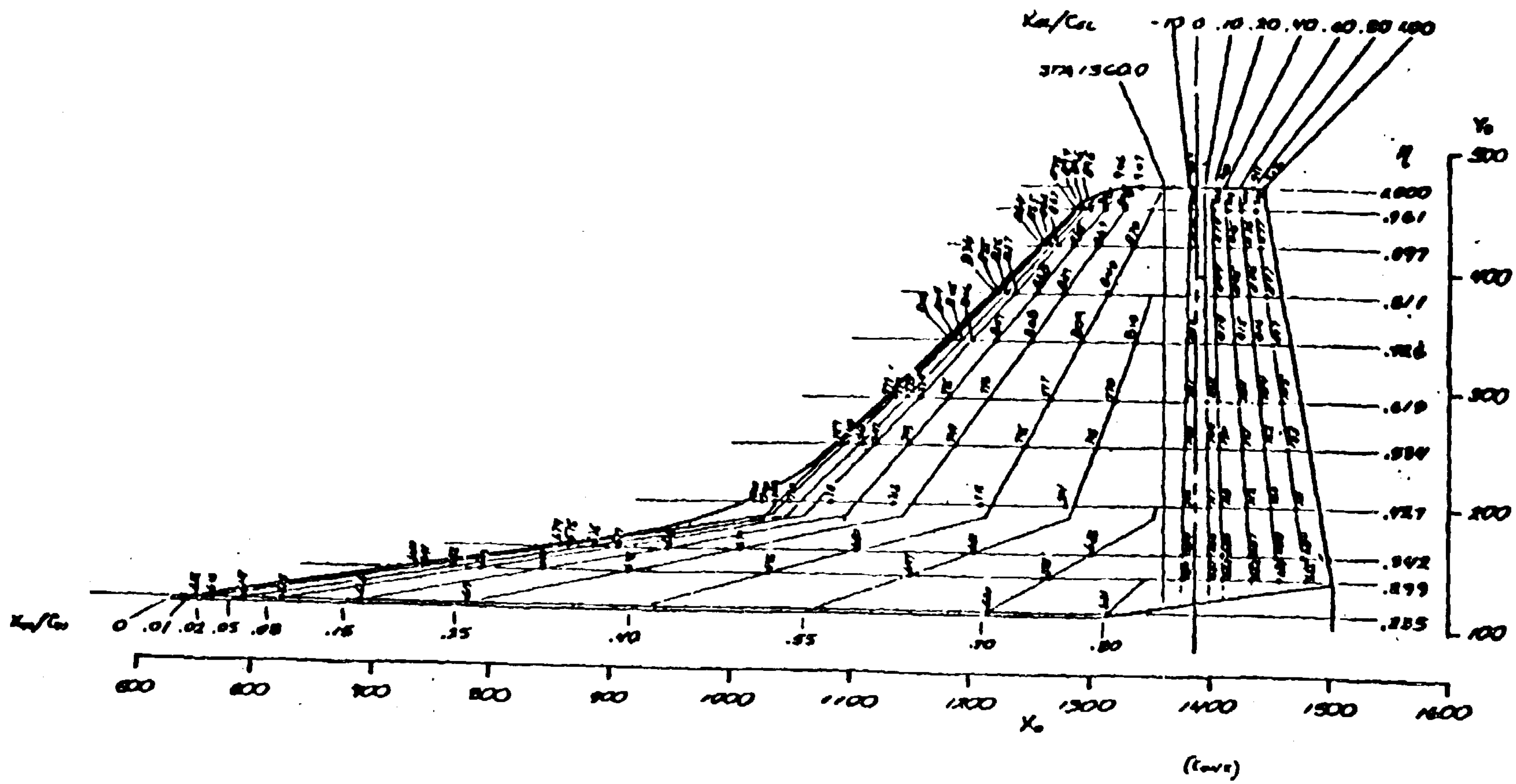
d. Vertical Tail Balance Cavity
Figure 4. (Concluded)

TABLE VI. ORBITER FUSELAGE SURFACE PRESSURE TAP LOCATIONS

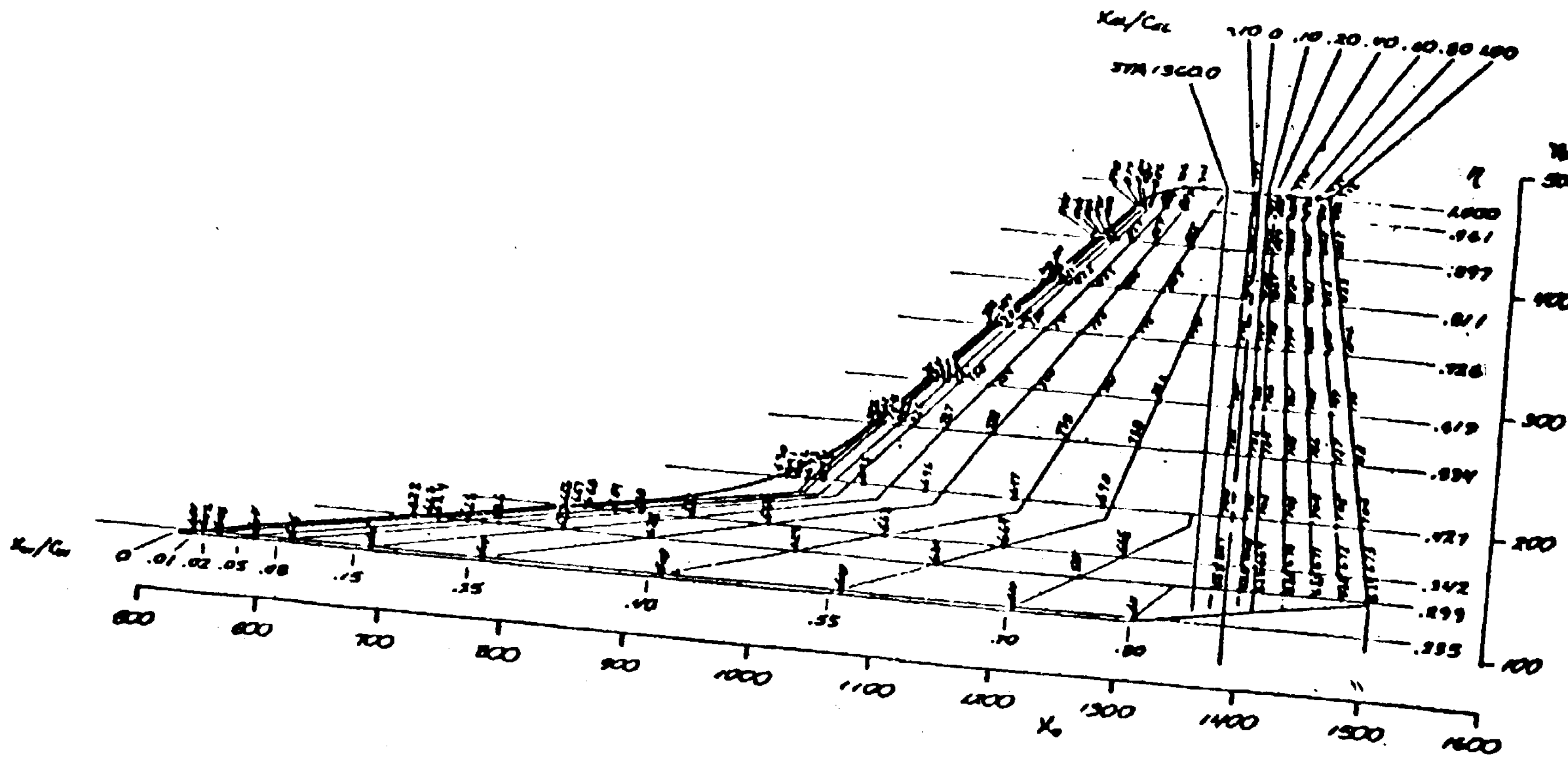
	ORBITER FUSELAGE PRESSURE TAP RADIAL LOCATION ~ ϕ ~ DEGREES																							
X_o/L_o	0	20	40	55	67.5	70	82	90	105	110	120	135	140	150	151	156	162	165	169	174	180	-55	-40	-20
0	1																							
.0078	2							3													4			
.0233	5	6	7	8		9		10			11			12							13	14	15	16
.0465	17	18	19	20		21		22			23			24							25	26	27	28
.0697	29	30	31	32		33		34			35			36							37	38	39	40
.1124	41	42	43	44		45		46			47			48							49	50	51	52
.1163								53																
.1271								54																
.1589																				55				
.1666	56	57	58	59		60		61			62					63			64		65	66	67	68
.1783															69		70							
.2054	71	72	73	74		75		76			77		78	79				80			81	82	83	84
.2364	85		86			87		88			89			90				91			92		93	
.2558	94		95			96		97			98			99				100			101		102	
.2751	103		104			105		106			107			108				109			110		111	
.3023	112		113			114		115			116			117				118			119		120	
.3526	121		122			123		124			125			126				127			128		129	
.4100							130																	
.4223	131		132			133		134			135			136				137			138		139	
.5192							140																	
.5348	141		142			143		144			145			146				147			148		149	
.5441					150																			
.5882							151																	
.6471	152		153			154		155			156			157				158			159		160	
.6929							161																	
.7595	162		163			164		165	166		167	168		169				170			171		172	
.8254	173		174			175		176	177		178	179		180							181		182	
.8835	183		184			185		186	187		188	189		190				191					192	
.8951						193																		
.9261	194		195			196		197	198		199	200		201				202					203	
.9649	204		205			206		207	208		209	210		211				212					213	
1.0036										214	215													
1.0036										216	217													

TABLE VII. WING PRESSURE TAP NUMBERS/LOCATIONS

η $2Y/B$	Y_o																			
.235		X/Cw TOP BOTT	0.00 601	0.01 602 612	0.02 603 613	0.05 604 614	0.08 605 615	0.15 606 616	0.25 607 617	0.40 608 618	0.55 609 619	0.70 610 620	0.80 611 621							
.299	140	X/Cw TOP BOTT	0.00 622	0.01 623 640	0.02 624 641	0.05 625 642	0.08 626 643	0.15 627 644	0.25 628 645	0.40 629 646	0.55 630 647	0.70 631 648	.816 632 649	0.836 633 650	0.866 634 651	0.881 635 652	0.911 636 653	0.941 637 654	0.971 638 655	1.00 639
.342	160	Y/Cw TOP BOTT	0.00 656	0.01 657 674	0.02 658 675	0.05 659 676	0.08 660 677	0.15 661 678	0.25 662 679	0.40 663 680	0.55 664 681	0.70 665 682	.784 666 683	[illegible] 667 684	0.843 668 685	0.861 669 686	0.895 670 687	0.930 671 688	0.964 672 689	1.00 673
.427	200	X/Cw TOP BOTT	0.00 690	0.01 691 707	0.02 692 708	0.05 693 709	0.08 694 710	0.15 695 711	0.25 696 712	0.40 697 713	0.55 698 714	.723 699 715	0.758 700 716	0.802 701 717	0.824 702 718	0.868 703 719	0.912 704 720	0.956 705 721	1.00 706	
.534	250	X/Cw TOP BOTT	0.00 722	0.01 723 739	0.02 724 740	0.05 725 741	0.08 726 742	0.15 727 743	0.25 728 744	0.40 729 745	0.55 730 746	.694 731 747	0.738 732 748	0.786 733 749	0.810 734 750	0.858 735 751	0.906 736 752	0.954 737 753	1.00 738	
.619	290	X/Cw TOP BOTT	0.00 754	0.01 755 771	0.02 756 772	0.05 757 773	0.08 758 774	0.15 759 775	0.25 760 776	0.40 761 777	0.55 762 778	.673 763 779	0.725 764 780	0.776 765 781	0.801 766 782	0.852 767 783	0.902 768 784	0.953 769 785	1.00 770	
.726	340	X/Cw TOP BOTT	0.00 786	0.01 787 803	0.02 788 804	0.05 789 805	0.08 790 806	0.15 791 807	0.25 792 808	0.40 793 809	0.55 794 810	.638 795 811	0.704 796 812	0.758 797 813	0.786 798 814	0.841 799 815	0.896 800 816	0.950 801 817	1.00 802	
.811	380	X/Cw TOP BOTT	0.00 818	0.01 819 834	0.02 820 835	0.05 821 836	0.08 822 837	0.15 823 838	0.25 824 839	0.40 825 840	.597 826 841	0.679 827 842	0.739 828 843	0.769 829 844	0.829 830 845	0.888 831 846	0.948 832 847	1.00 833		
.897	420	X/Cw TOP BOTT	0.00 848	0.01 849 864	0.02 850 865	0.05 851 866	0.08 852 867	0.15 853 868	0.25 854 869	0.40 855 870	.536 856 871	0.622 857 872	0.709 858 873	0.742 859 874	0.809 860 875	0.876 861 876	0.942 862 877	1.00 863		
.961	450	X/Cw TOP BOTT	0.00 878	0.01 879 893	0.02 880 894	0.05 881 895	0.08 882 896	0.15 883 897	0.25 884 898	.411 885 899	0.538 886 900	0.641 887 901	0.682 888 902	0.765 889 903	0.848 890 904	0.932 891 905	1.00 892			
1.00	TIP	X/Cw TOP BOTT						0.15 906	0.25 907	.423 908	0.579 909	0.779 910	0.939 911	1.00 912						



a. Lower Surface
Figure 5. Wing Pressure Tap Locations



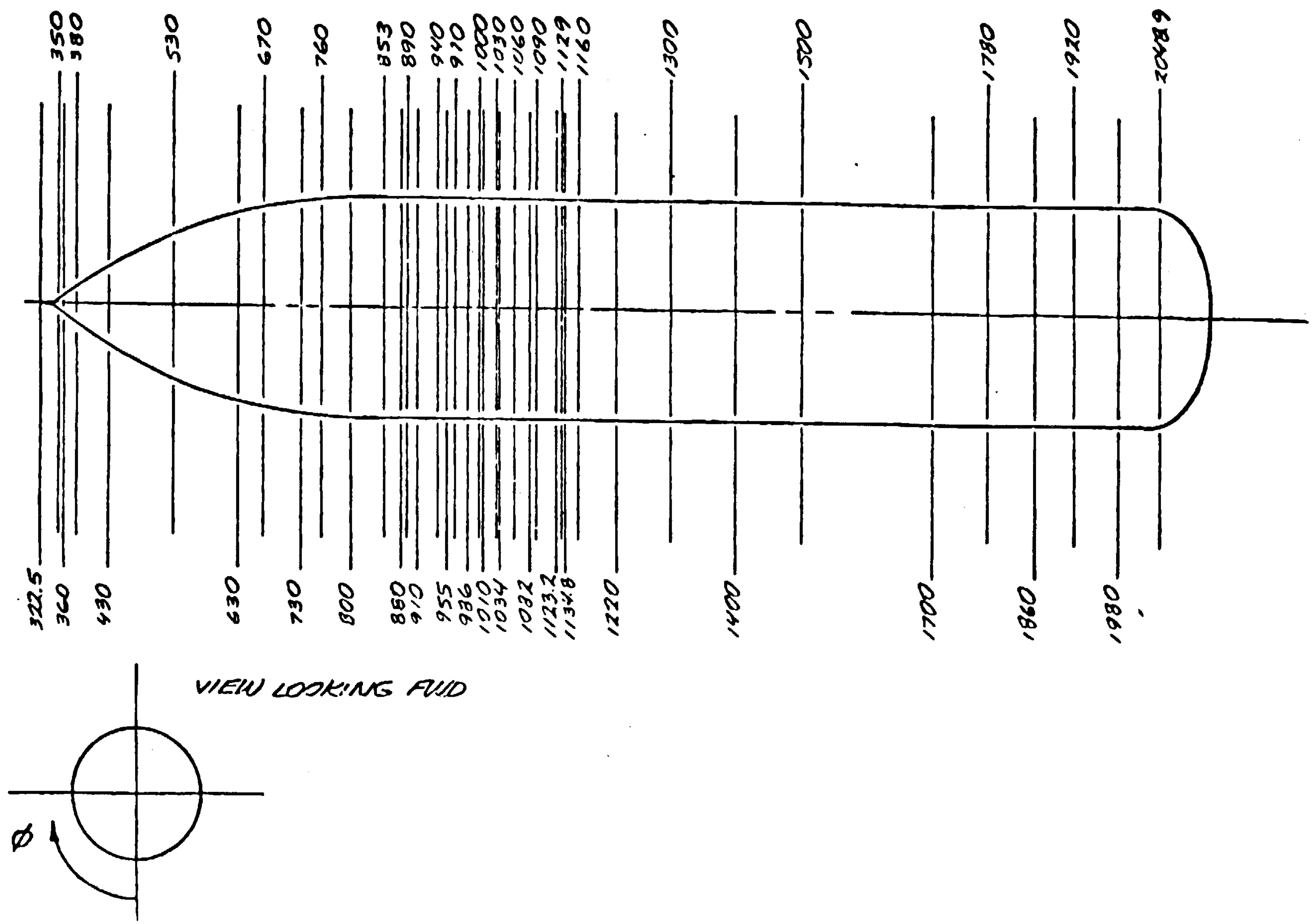
b. Upper Surface
Figure 5. (Concluded)

TABLE VIII. EXTERNAL TANK SURFACE PRESSURE TAP LOCATIONS

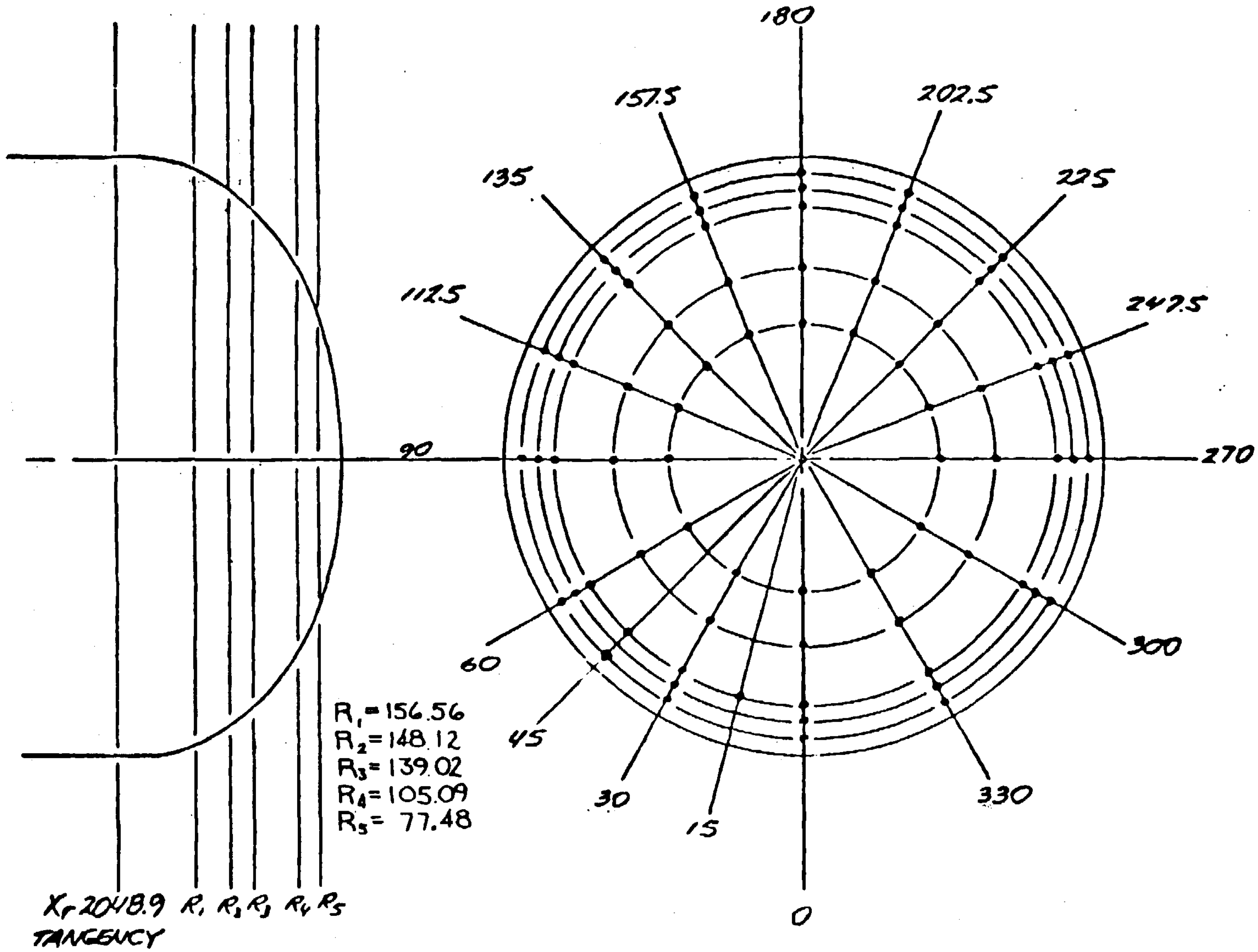
X_T	ET PRESSURE TAP LOCATION ~ ϕ ~ DEG												
	0	25	30	60	85	87	90	93	95	1125	135	157.5	165
322.5	1001												
350	1002			1003			1004				1005		
360	1010			1011			1012				1013		
380	1018		1019	1020			1021			1022	1023	1024	
430	1032		1033	1034			1035			1036	1037	1038	
530	1046		1047	1048			1049			1050	1051	1052	
630	1060		1061	1062			1063			1064	1065	1066	
670	1074		1075	1076			1077			1078	1079	1080	
730	1088		1089	1090			1091			1092	1093	1094	
760	1102		1103	1104			1105			1106	1107	1108	
800	1116		1117	1118			1119			1120	1121	1122	
847	1130		1131	1132			1133			1134	1135	1136	
880	1144			1145			1146			1147	1148	1149	
890		1155											
910	1157			1158			1159			1160	1161	1162	
940	1168		1169	1170			1171			1172	1173	1174	
955					1182	1183	1184	1185	1186				
970	1192			1193	1194				1195	1196	1197	1198	
986					1207				1208				
1000	1214			1215	1216				1217	1218	1219	1220	
1010													
1030	1228		1229	1230			1231			1232	1233	1234	
1034													
1060	1244			1245			1246			1247	1248	1249	
1082													
1090	1258			1259			1260			1261	1262	1263	
1123.2	1269		1270	1271			1272			1273	1274		1275
1129												1281	
1134.8													1284
1160	1285			1286			1287			1288	1289	1290	
1220	1296		1297	1298			1299			1300	1301	1302	
1300	1309		1310	1311			1312			1313	1314	1315	
1400	1322		1323	1324			1325			1326	1327	1328	
1500	1335		1336	1337			1338			1339	1340	1341	
1700	1348		1349	1350			1351			1352	1353	1354	
1780	1361		1362	1363			1364			1365	1366	1367	
1860	1374		1375	1376			1377			1378	1379	1380	
1920	1387		1388	1389			1390			1391	1392	1393	
1980	1400		1401	1402			1403			1404	1405	1406	
2045	1413		1414	1415			1416			1417	1418	1419	

TABLE VIII. EXTERNAL TANK SURFACE PRESSURE TAP LOCATIONS (Concluded)

X_T	ET PRESSURE TAP LOCATION ~ ϕ ~ DEG												
	172.5	180	182.5	195	202.5	210	214	220	225	247.5	270	300	330
322.5		1001											
350		1006							1007		1008	1009	
360		1014							1015		1016	1017	
380		1025			1026				1027	1028	1029	1030	1031
430		1039			1040				1041	1042	1043	1044	1045
530		1053			1054				1055	1056	1057	1058	1059
630		1067			1068				1069	1070	1071	1072	1073
670		1081			1082				1083	1084	1085	1086	1087
730		1095			1096				1097	1098	1099	1100	1101
760		1109			1110				1111	1112	1113	1114	1115
800		1123			1124				1125	1126	1127	1128	1129
847		1137			1138				1139	1140	1141	1142	1143
880		1150			1151				1152	1153	1154		
890			1156										
910		1163			1164				1165	1166	1167		
940		1175			1176				1177	1178	1179	1180	1181
955				1187	1188	1189	1190	1191					
970		1199		1200	1201	1202	1203	1204	1205	1206			
986				1209	1210	—	1212	1213					
1000		1221							1222	1223		1224	
1010				1225		1226		1227					
1030		123							1236	1237	1238	1239	1240
1034				1241		1242		1243					
1060		1250							1251	1252	1253	1254	
1082		1255		1256		1257							
1090		1264							1265	1266	1267	1268	
1123.2									1276	1277	1278	1279	1280
1129	1282	1283											
1134.8													
1160		1291							1292	1293	1294	1295	
1220		1303							1304	1305	1306	1307	1308
1300		1316							1317	1318	1319	1320	1321
1400		1329							1330	1331	1332	1333	1334
1500		1342							1343	1344	1345	1346	1347
1700		1355							1356	1357	1358	1359	1360
1780		1368							1369	1370	1371	1372	1373
1860		1381							1382	1383	1384	1385	1386
1920		1394							1395	1396	1397	1398	1399
1980		1407							1408	1409	1410	1411	1412
2045		1420							1421	1422	1423	1424	1425



a. ET Station Numbers
Figure 6. External Tank Pressure Tap Locations



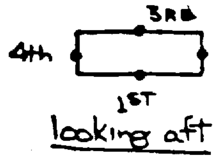
b. External Tank Base
Figure 6. (Concluded)

TABLE IX. EXTERNAL TANK BASE PRESSURE TAP LOCATIONS

RADIUS	ET BASE PRESSURE TAP LOCATIONS ~ ϕ ~ DEGREES															
FULL SC.	0	15	30	45	60	90	112.5	135	157.5	180	202.5	225	247.5	270	300	330
156.56	1502		1503	1501	1504	1505	1506	1507	1508	1509	1510	1511	1512	1513	1514	1515
148.12	1516		1517		1518	1519	1520	1521	1522	1523	1524	1525	1526	1527	1528	1529
139.02	1530	1531	1532	1533	1534	1535	1536	1537	1538	1539	1540	1541	1542	1543	1544	1545
105.09	1546		1547		1548	1549	1550	1551	1552	1553	1554	1555	1556	1557	1558	1559
77.48	1560		1561		1562	1563	1564	1565	1566	1567	1568	1569	1570	1571	1572	1573
0	1574															

• LO_2 TANK CABLE TRAY (44 TAPS)

TAPS # 1601 → 1644



4 TAPS AS SHOWN FOR THE FOLLOWING

STATIONS:	458	573	697	811
	495	614	739	845
	534	655	777	

• LH_2 TANK CABLE TRAY (52 TAPS)

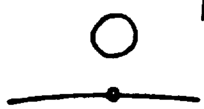
TAPS # 1645 → 1696

4 TAPS AS SHOWN FOR THE FOLLOWING

STATIONS:	1238	1496	1754	2008
	1302	1561	1820	
	1367	1625	1884	
	1431	1690	1948	

• GO_2 PRESSURE LINE (28 TAPS)

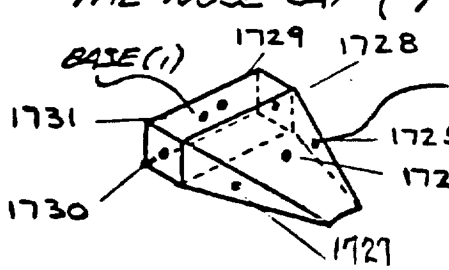
TAPS # 1697 → 1724



1 TAP AS SHOWN FOR THE FOLLOWING

STATIONS:	461	736	1180	1625
	495	777	1238	1690
	534	818	1302	1754
	573	840	1367	1820
	602	880	1431	1884
	655	980	1496	1948
	697	1080	1561	2008

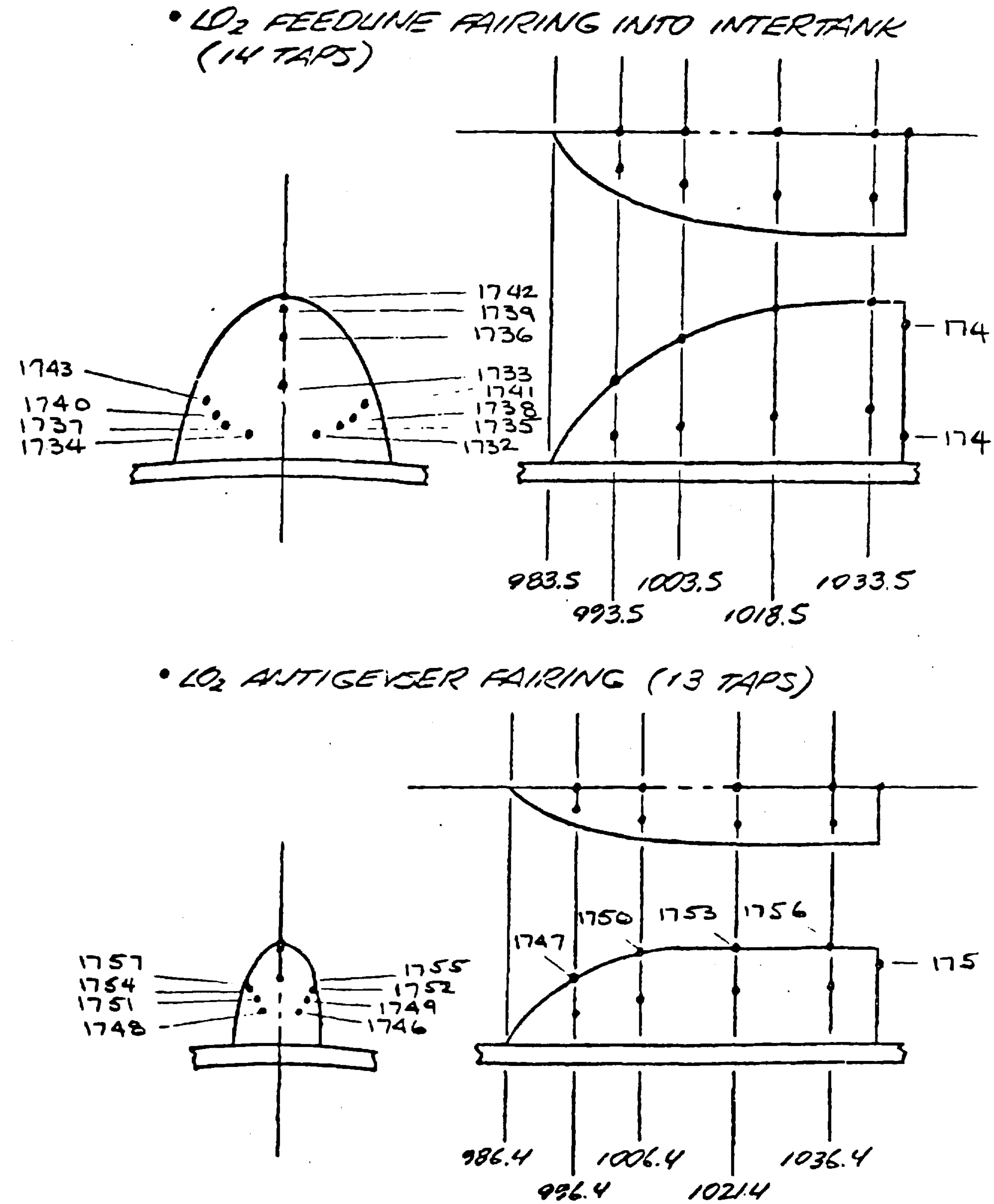
• GO_2 PRESSURE LINE & CABLE TRAY FAIRING ON THE NOSE CAP (7 TAPS)



1 TAP MIDDLE OF SIX SIDES

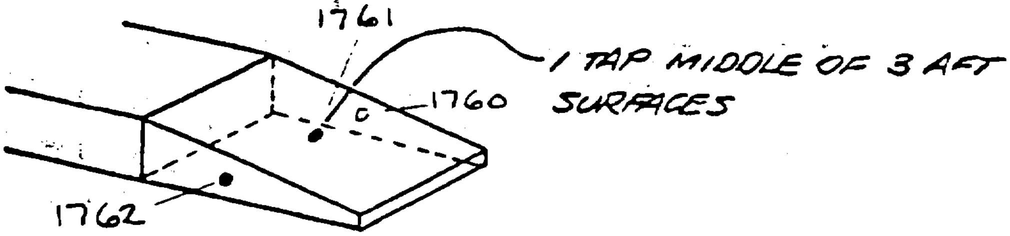
a. Taps 1601 → 1724

Figure 7. External Tank Protuberance Pressure Tap Locations

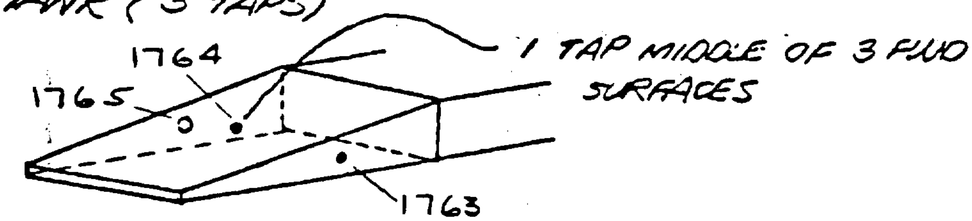


b. Taps 1732 → 1759
Figure 7. (Continued)

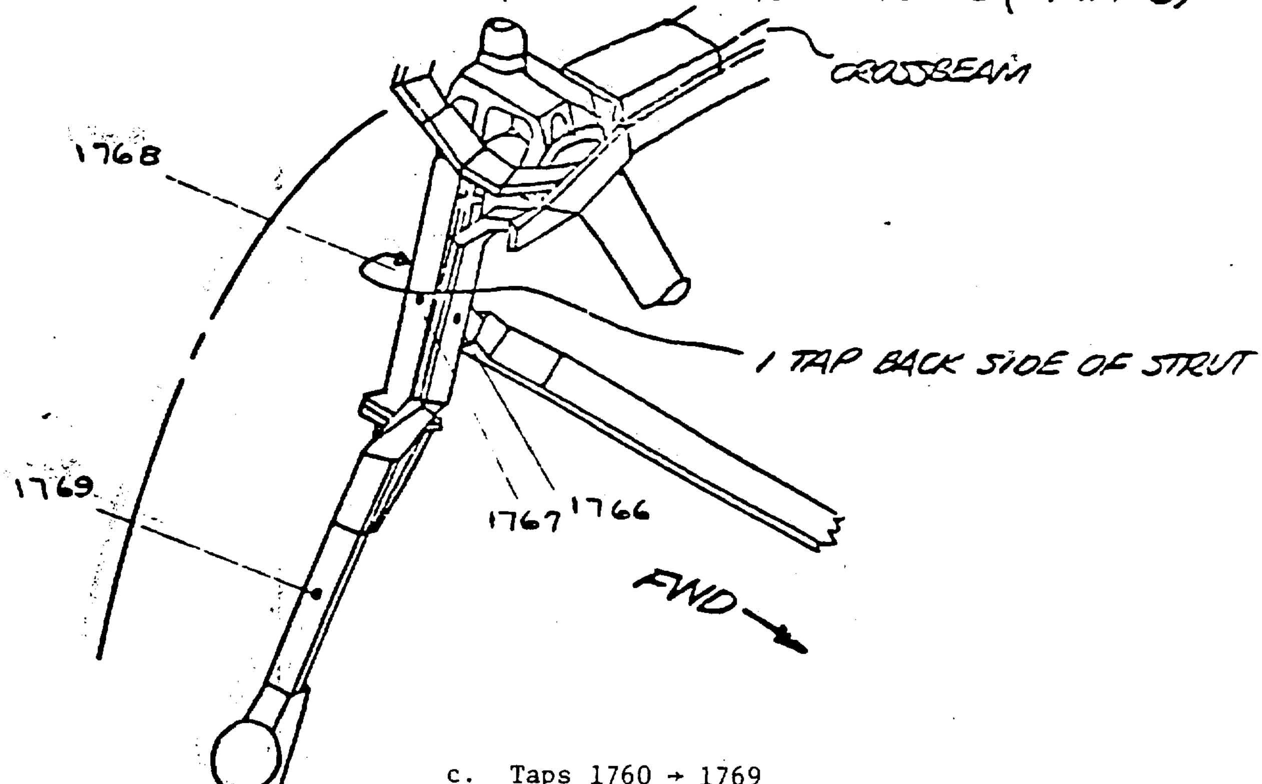
• OGIVE CABLE TRAY INTERTANK PENETRATION FAIRING (3 TAPS)



• INTERTANK CABLE TRAY FAIRING FOR LH_2 TANK (3 TAPS)

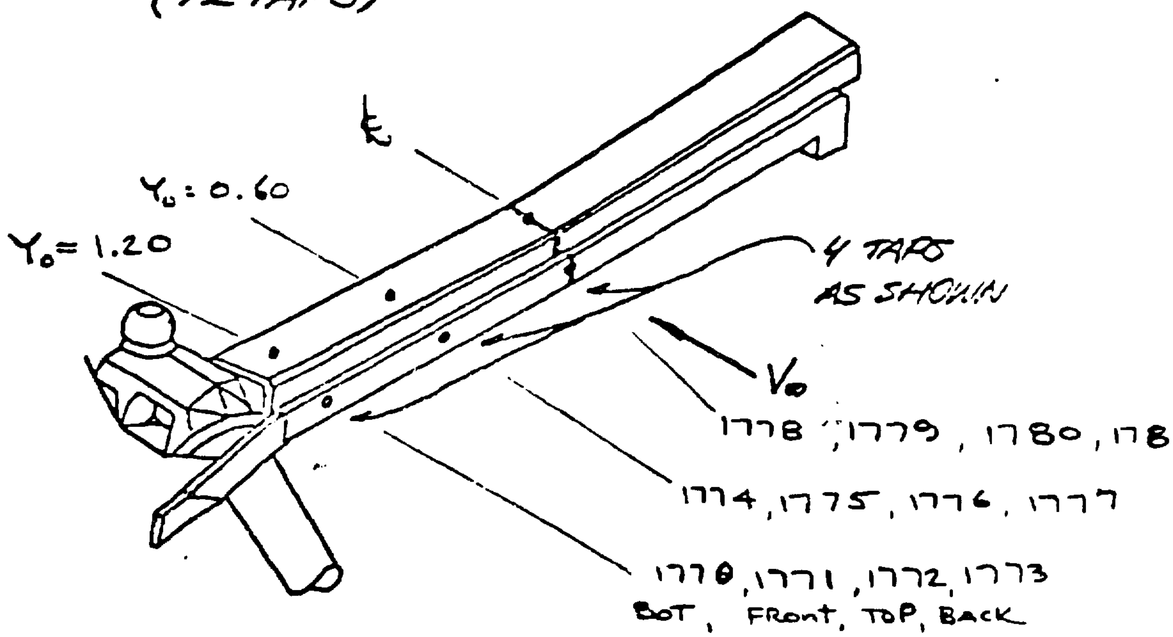


• AFT ET ATTACHMENT CABLE TRAYS (4 TAPS)

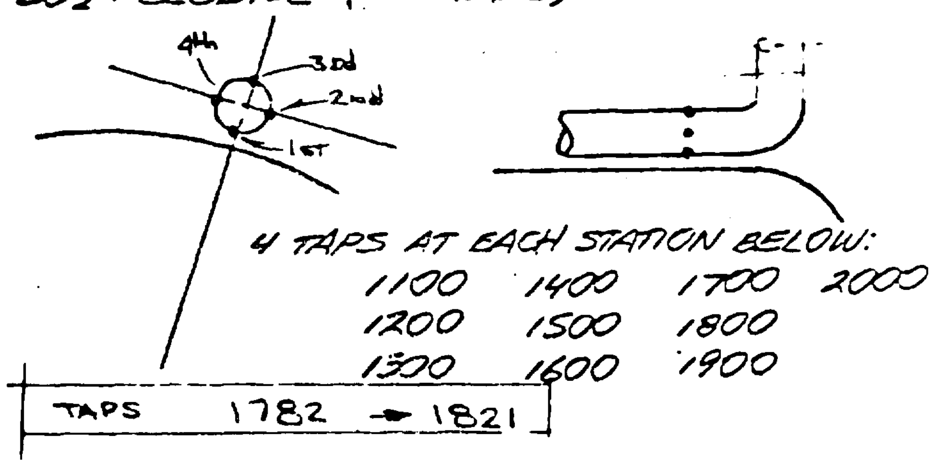


c. Taps 1760 → 1769
Figure 7. (Continued)

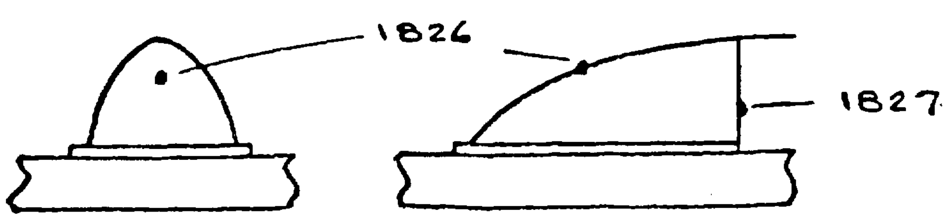
• AFT ATTACH STRUCTURE CROSSBEAM (12 TAPS)



• LO_2 FEEDLINE (40 TAPS)



• GH_2 PRESSURE LINE FAIRING (2 TAPS)

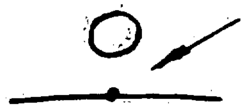


d. Taps 1770 → 1827

Figure 7. (Continued)

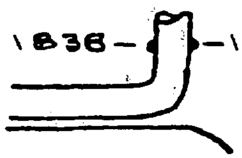
• GH_2 PRESSURE LINE (12 TAPS)

1828 → 1837



1 TAP AS SHOWN FOR THE FOLLOWING STATIONS:

1100	1400	1700	2000
1200	1500	1800	
1300	1600	1900	



2 TAPS AS SHOWN (WINDWARD/LEEWARD
LOCATED 1/2 HEIGHT

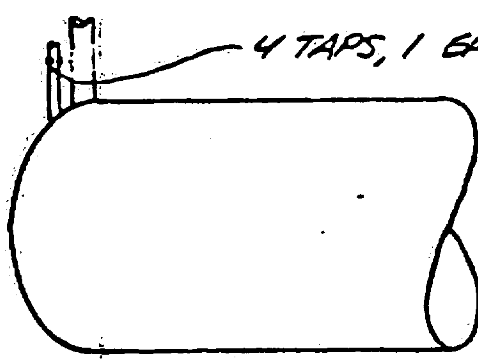
• LO_2 ANTIGEYSER LINE (10 TAPS)

1840 → 1849

1 TAP AS SHOWN FOR THE FOLLOWING STATIONS:

1100	1400	1700	2000
1200	1500	1800	
1300	1600	1900	

• LH_2 RECIRCULATION LINE (4 TAPS)



4 TAPS, 1 EACH @ 0°, 90°, 180°, 270° (54-57)
1854 → 1857
LOCATE TAPS AT 1/2
HEIGHT

e. Taps 1828 → 1857
Figure 7. (Continued)

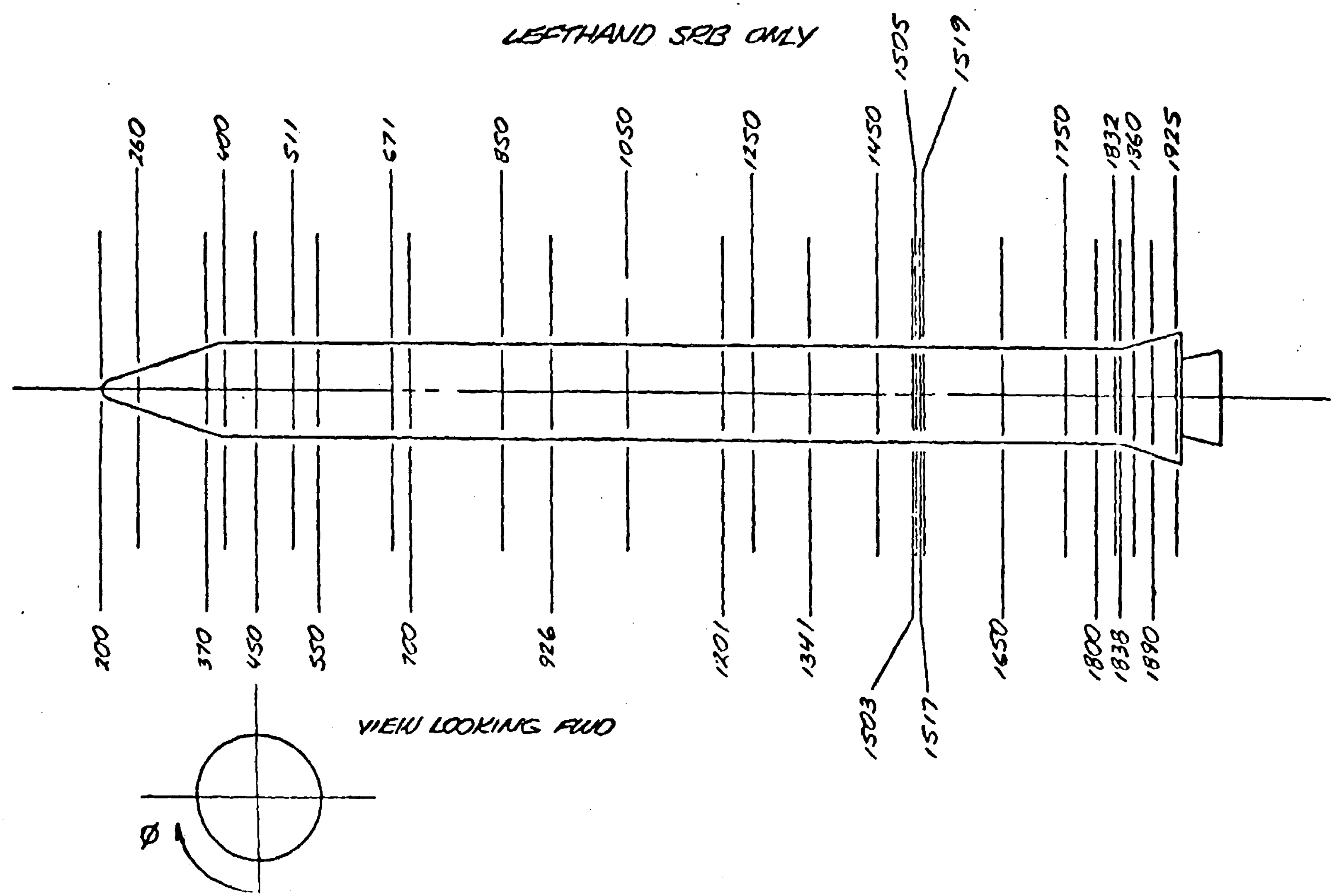
DESCRIPTION	# TAPS	FROM #	TO #
LO_2 TANK CABLE TRAY	44	1601	1644
LH_2 TANK CABLE TRAY	52	1645	1696
GO_2 PRESSURE LINE	28	1697	1724
GO_2 PRESSURE LINE & CABLE TRAY NOSE FAIRING	7	1725	1731
LO_2 FEEDLINE FAIRING	14	1732	1745
LO_2 ANTIGEYSER FAIRING	13	1746	1759
OGIVE CABLE TRAY FAIRING	3	1760	1762
INTERTANK CABLE TRAY FAIRING	3	1763	1765
AFT ET ATTACH CABLE TRAY	4	1766	1769
AFT ET ATTACH CROSSBEAM	12	1770	1781
LO_2 FEEDLINE	40	1782	1821
GH_2 PRESSURE LINE FAIRING	2	1826	1827
GH_2 PRESSURE LINE	12	1828	1839
LO_2 ANTIGEYSER LINE	10	1840	1849
LH_2 FEED & RECIRCULATION LINE	4	1854	1857

$\Sigma = 242$

f. External Tank Protuberance Pressures Summary
Figure 7. (Concluded)

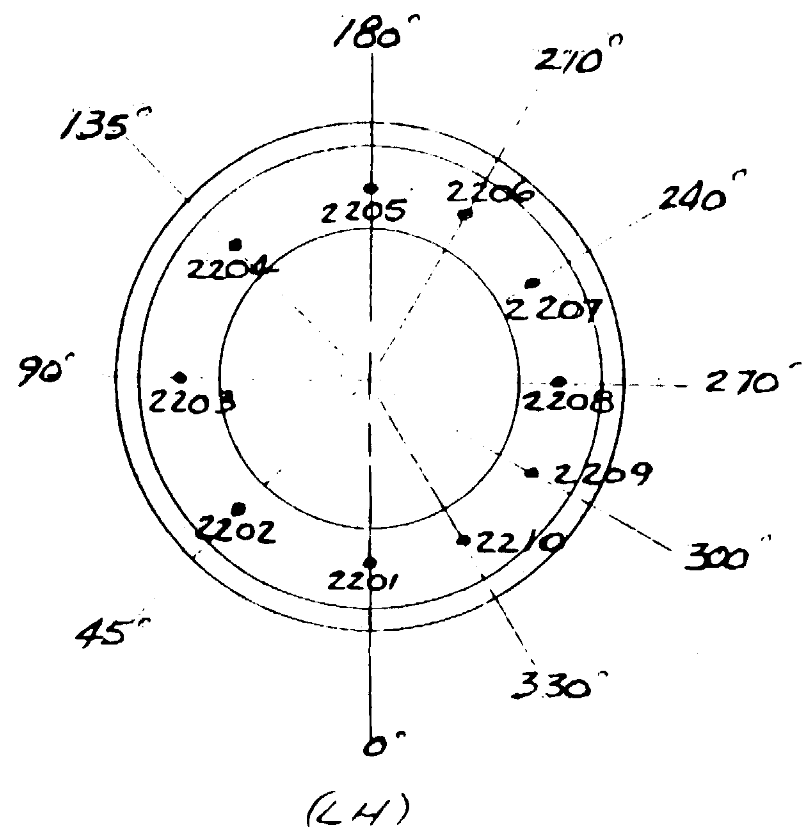
TABLE X. SOLID ROCKET BOOSTER SURFACE PRESSURE TAP LOCATIONS

STA \ ϕ	0	45	86	90	94	135	180	225	247.5	270	292.5	315
200	2001	—	—	—	—	—	2001	—	—	—	—	—
260	2002	2003	—	2004	—	2005	2006	2007	—	2008	—	2009
370	2010	2011	—	2012	—	2013	2014	2015	—	2016	—	2017
400	2018	2019	—	2020	—	2021	2022	2023	—	2024	—	2025
450	2026	2027	—	—	—	2028	2029	2030	—		—	2032
511	—	—	2033	—	2034	—	—	—	—	—	—	—
550	2035	2036	—	—	—	2037	2038	2039	—	2040	—	2041
671	—	—	2042	—	2043	—	—	—	—	—	—	—
700	2044	2045	—	—	—	2046	2047	2048	—	2049	—	2050
850	2051	2052	—	—	—	2053	2054	2055	—	2056	—	2057
926	—	—	2058	—	2059	—	—	—	—	—	—	—
1050	2060	2061	2062	—	2063	2064	2065	2066	—	2067	—	2068
1201	—	—	2069	—	2070	—	—	—	—	—	—	—
1250	2071	2072	—	—	—	2073	2074	2075	—	2076	—	2077
1341	—	—	2078	—	2079	—	—	—	—	—	—	—
1450	2080	2081	—	—	—	2082	2083	2084	—	2085	—	2086
1503	2087	2088	2089	—	2090	2091	2092	2093	—	2094	—	2095
1505	2096	2097	—	—	—	2098	2099		—	2101	—	
1517	2103	2104	—	—	—	2105	2106		—	2108	—	
1519	—	—	—	—	2110	—	—	—	—	—	—	—
1650	2111	2112	2113	—	2114	2115	2116	2117	—	2118	—	2119
1750	2120	2121	—	—	—	2122	2123	2124	—	2125	—	2126
1800	2127	2128	2129	—	2130	2131	2132	2133	—	2134	—	2135
1832	2136	2137	—	—	—	2138	2139	2140	—	2141	—	2142
1838	2143	2144	—	—	—	2145	2146	2147	—	2148	—	2149
1860	2150	2151	—	2152	—	2153	2154	2155	2156	2157	2158	2159
1890	2160	2161	—	2162	—	2163	2164	2165	2166	2167	2168	2169
1925	2170	2171	—	2172	—	2173	2174	2175	2176	2177	2178	2179



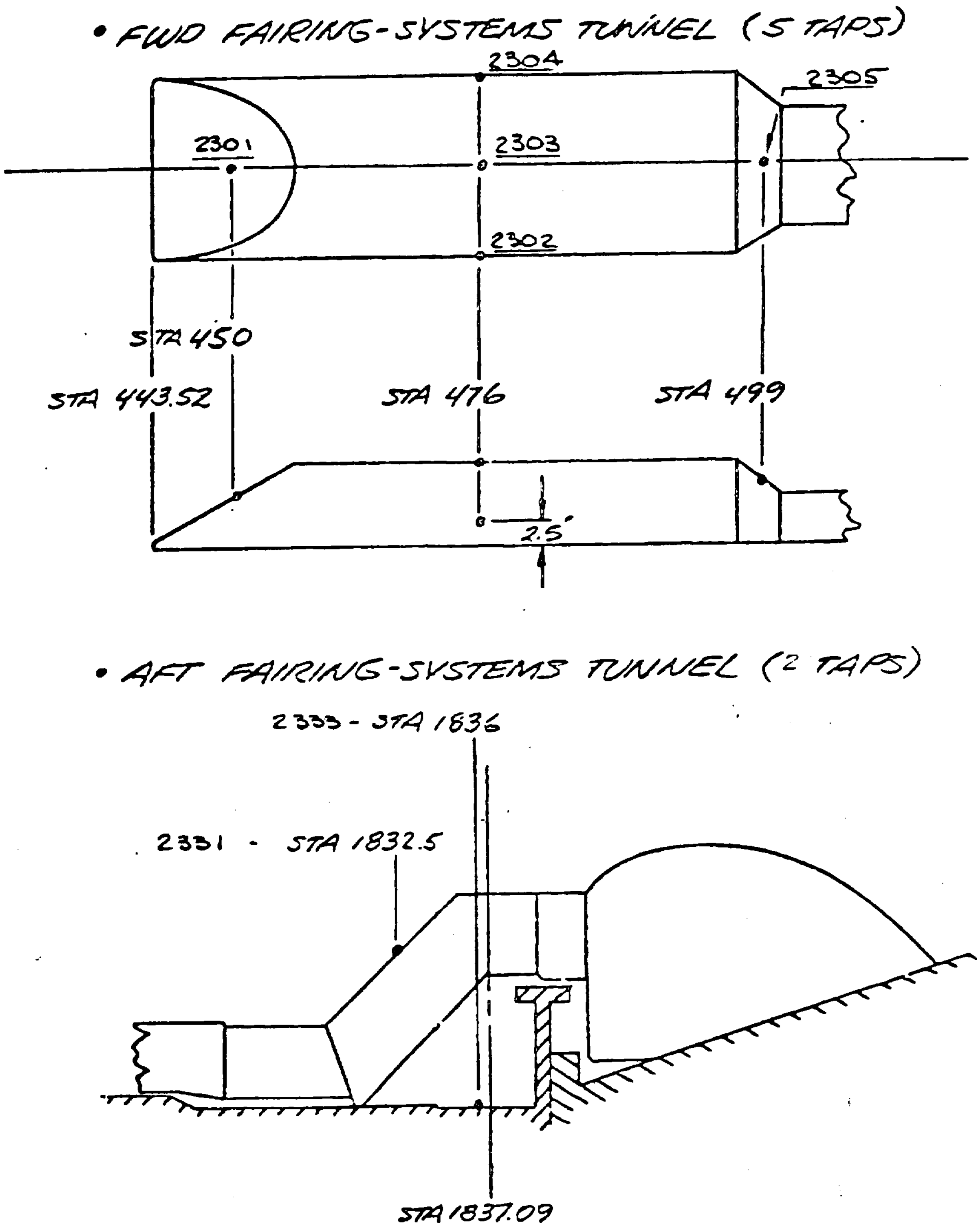
a. SRB Station Numbers

Figure 8. Solid Rocket Booster Pressure Tap Locations



NOTE:
PRESSURE TAPS ARE ½ WAY BETWEEN NOZZLE AND SKIRT.

b. SRB Base
Figure 8. (Concluded)



a. Systems Tunnel Ends

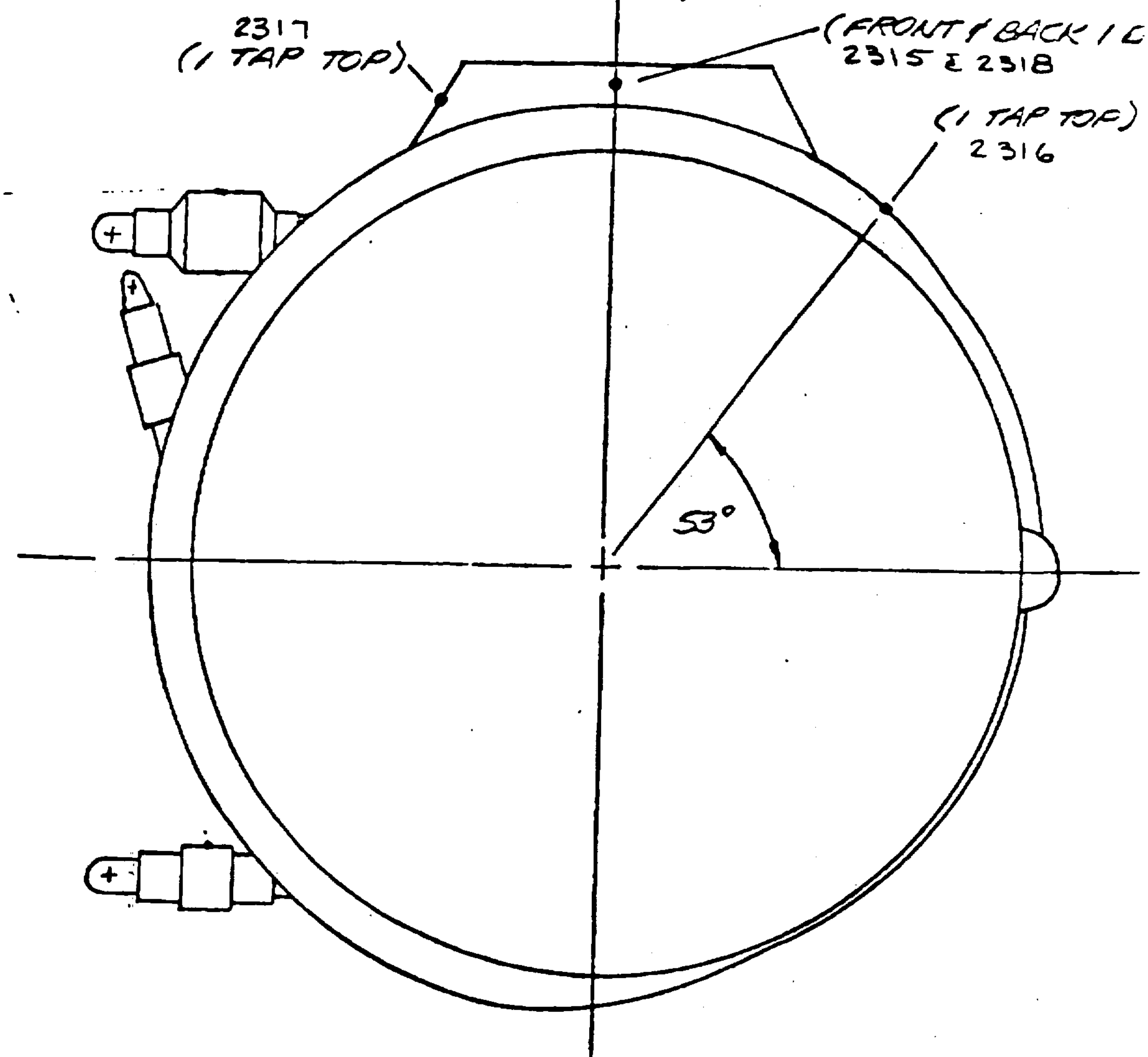
Figure 9. SRB Protuberance Pressure Tap Locations

• CENTER SECTION–SYSTEMS TUNNEL (13 TAPS)

• 1 TAP LOCATED TOP CENTERLINE OF FAIRING AT THE FOLLOWING SRB STATIONS:

TAP No	X_B	TAP No	X_B	TAP No	X_B	TAP No	X_B	TAP No	X_B
2306	511	2309	811	2312	1201	2327	1591	2330	1800
2307	561	2310	926	2313	1341	2328	1650		
2308	671	2311	1051	2314	1503	2329	1726		

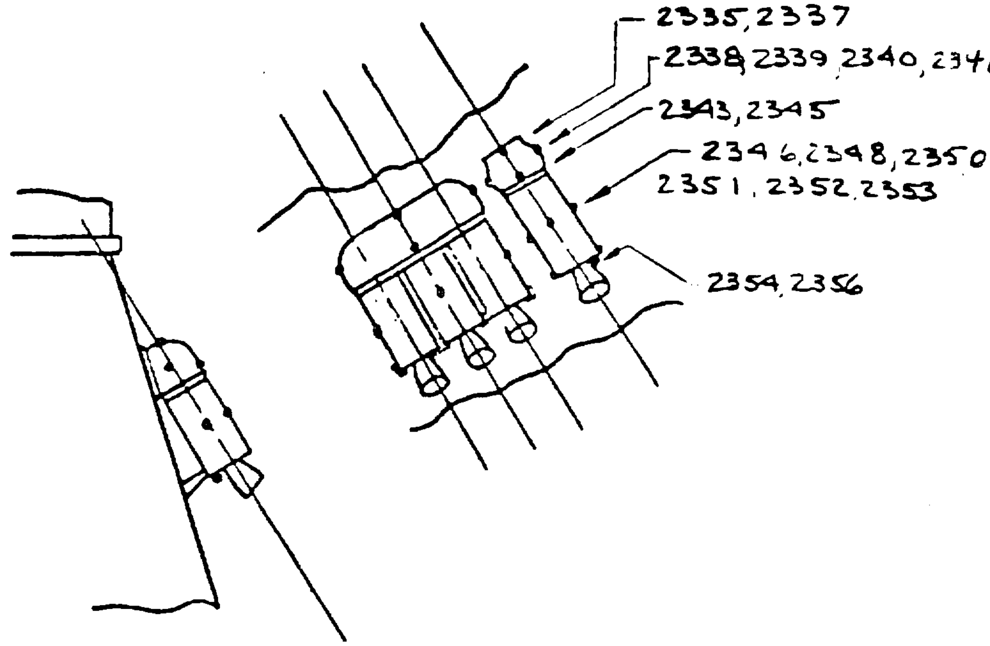
• ET ATTACH RING (4 TAPS)



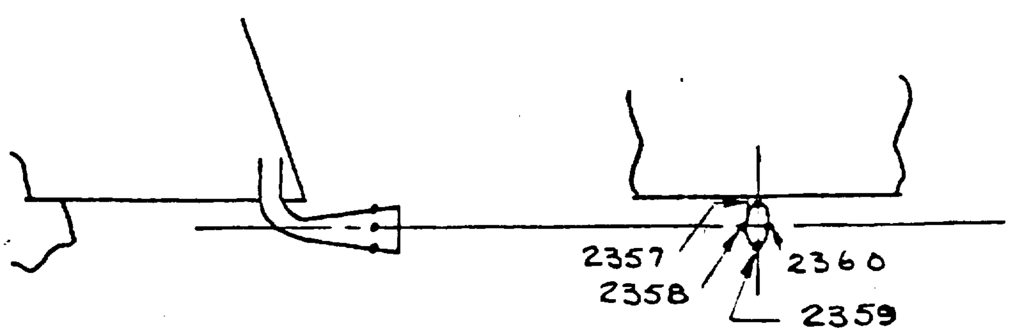
VIEW LOOKING AFT

b. Systems Tunnel and Attach Ring
Figure 9. (Continued)

• SEPARATION MOTOR FAIRINGS (16 TAPS)



• TURBINE EXHAUST (4 TAPS).

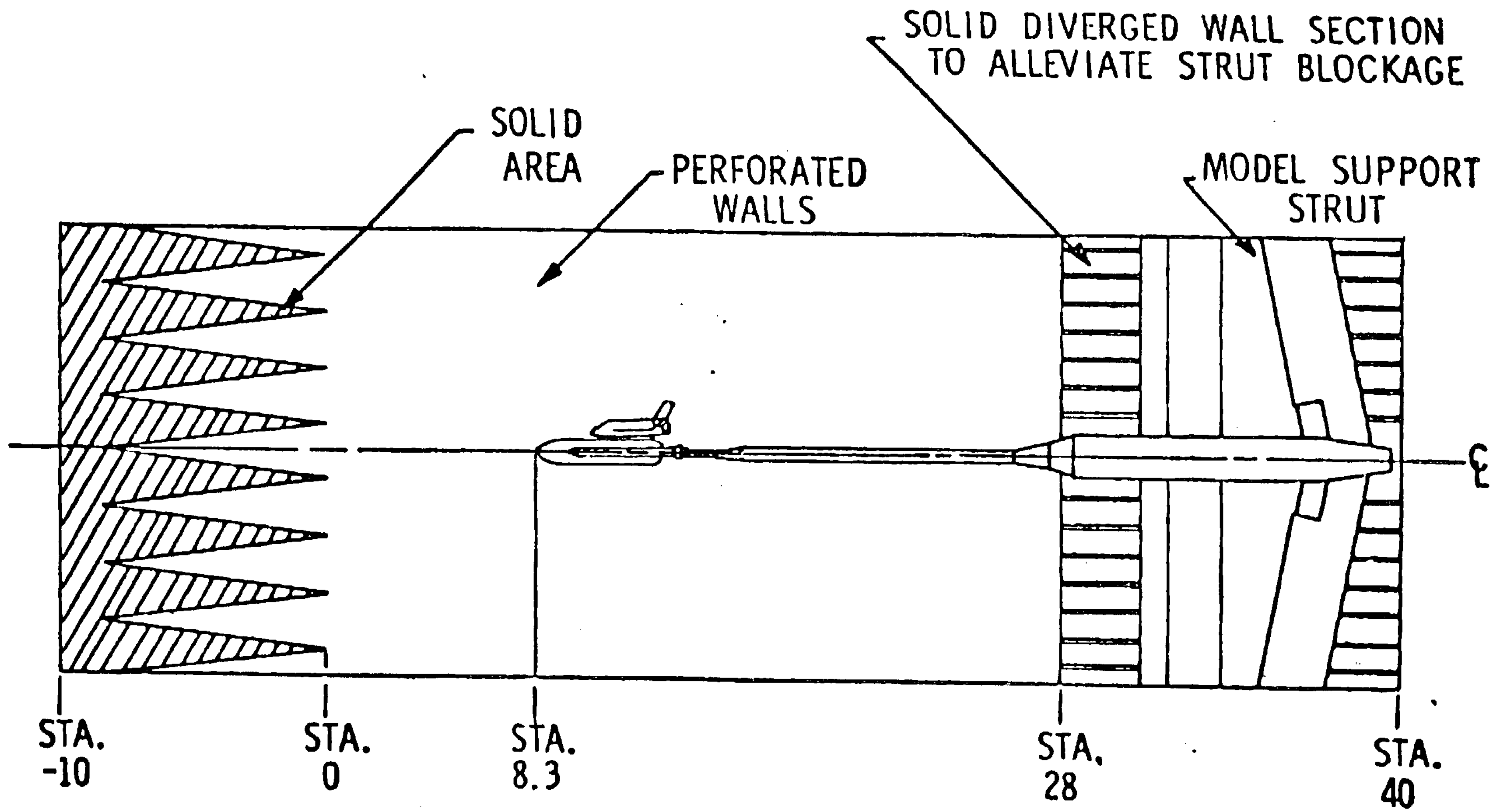


c. Separation Motors and Turbine Exhaust
Figure 9. (Continued)

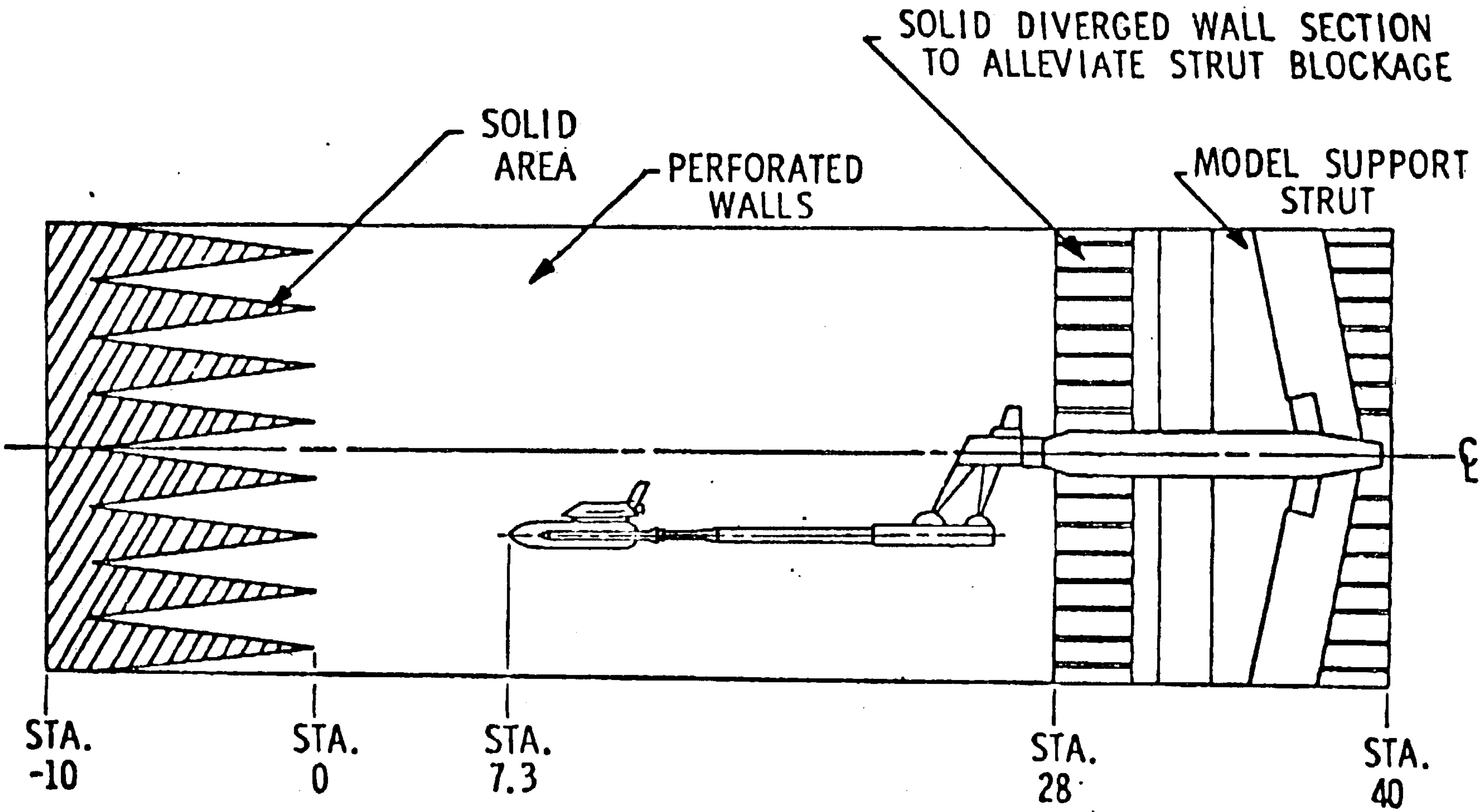
DESCRIPTION	TAPS	FROM #	TO #
FWD FAIRING - SYSTEMS TUNNEL	5	2301	2305
CENTER SECTION - UP TO REAR ATTACH RING - OF SYSTEMS TUNNEL	9	2306	2314
AFT ATTACH RING	4	2315	2318
CENTER SECTION - AFT OF ATTACH RING - OF SYSTEMS TUNNEL	4	2327	2330
AFT FAIRING - SYSTEMS TUNNEL (TAP 2332 DELETED)	2	2331	2333
REAR SEPARATION THRUSTORS - (TAP 2334, 2336, 2342, 2344, 2347, 2349 2355 DELETED)	16	2335	2356
APU TURBINE EXHAUST	3	2357	2359

$\Sigma = 43$

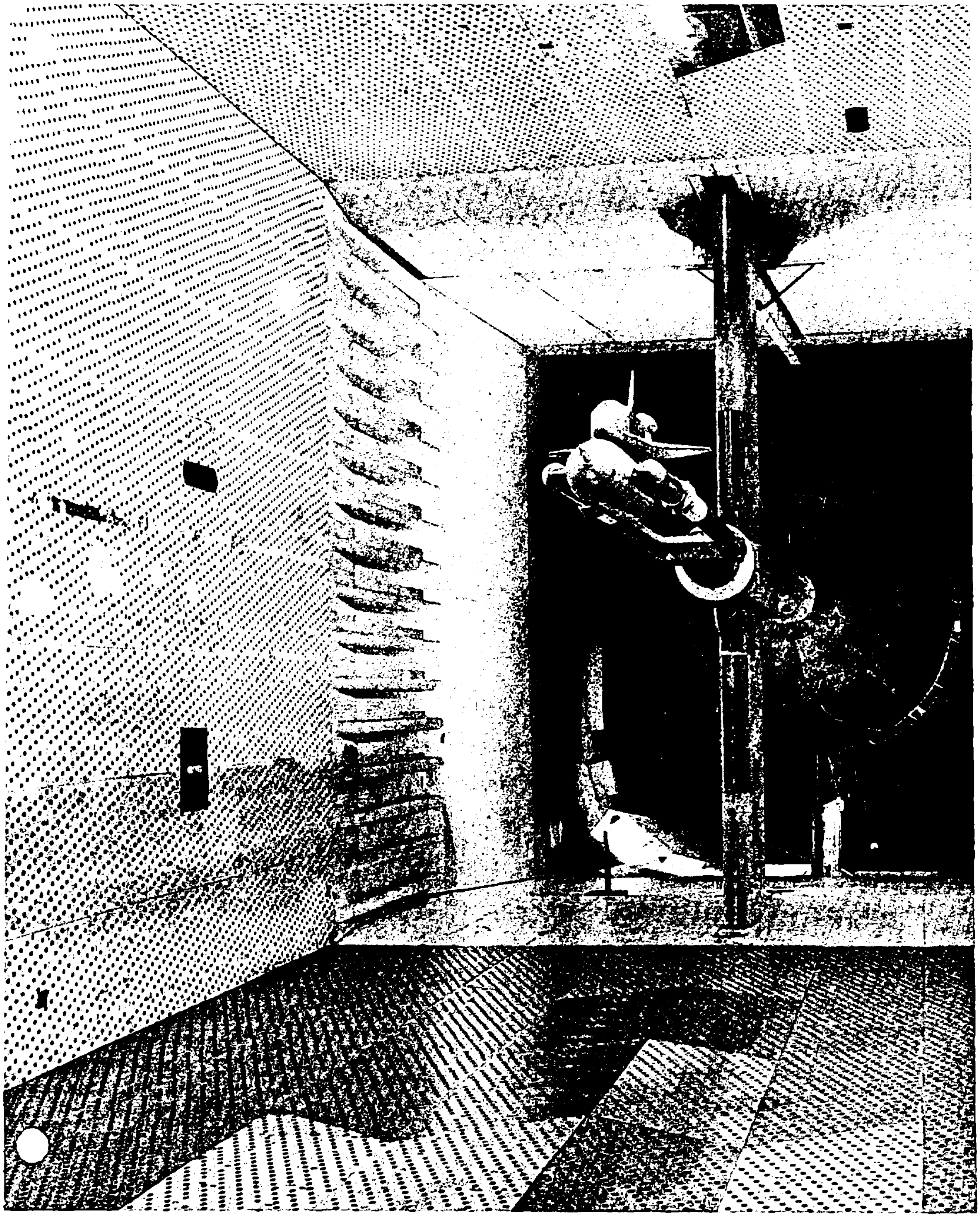
d. SRB Protuberance Pressures Summary
Figure 9. (Concluded)



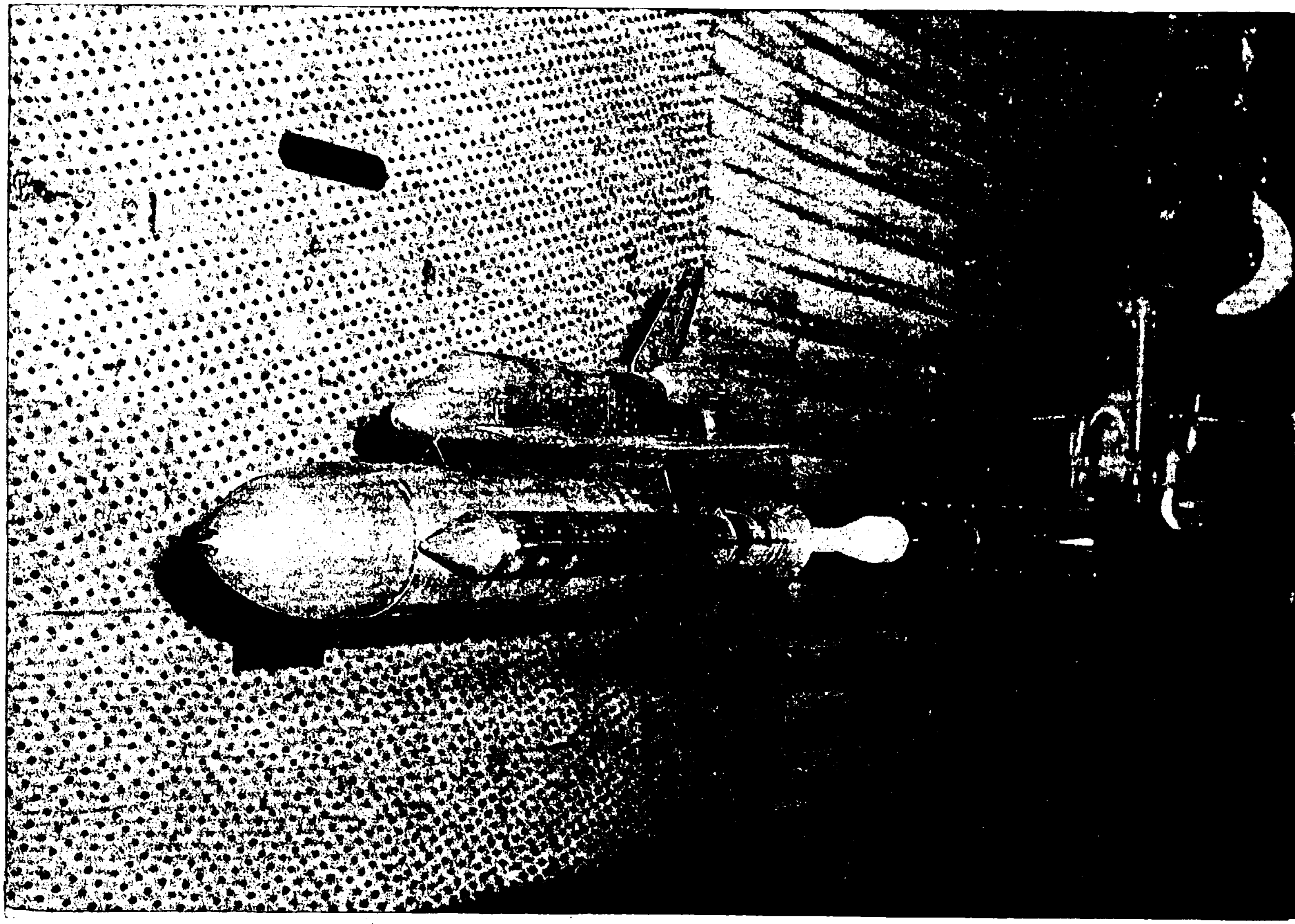
a. First Entry (Straight Sting)
Figure 10. Model Installation in the AEDC 16T



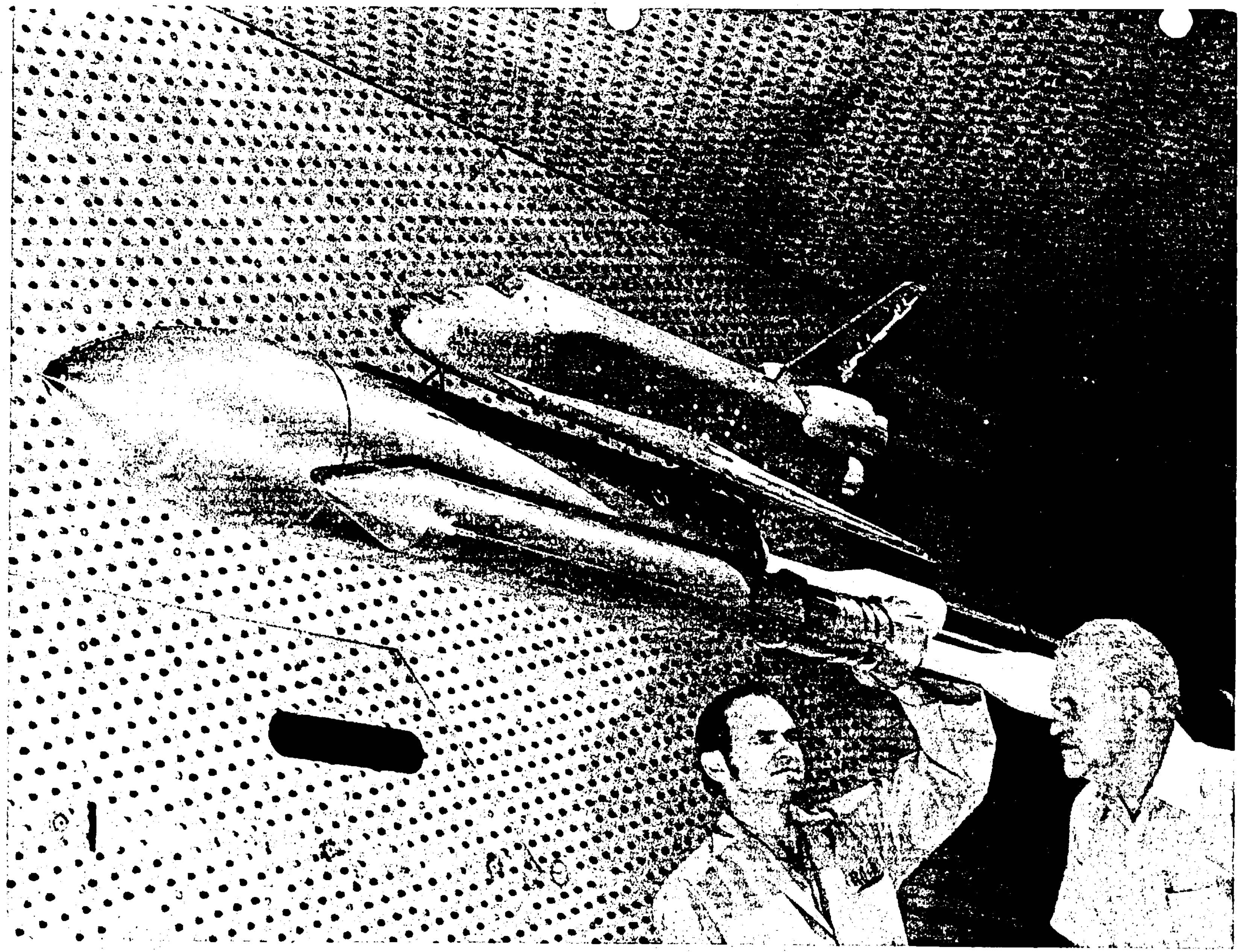
b. Second Entry (Hi-Pitch Sting)
Figure 10. (Concluded)



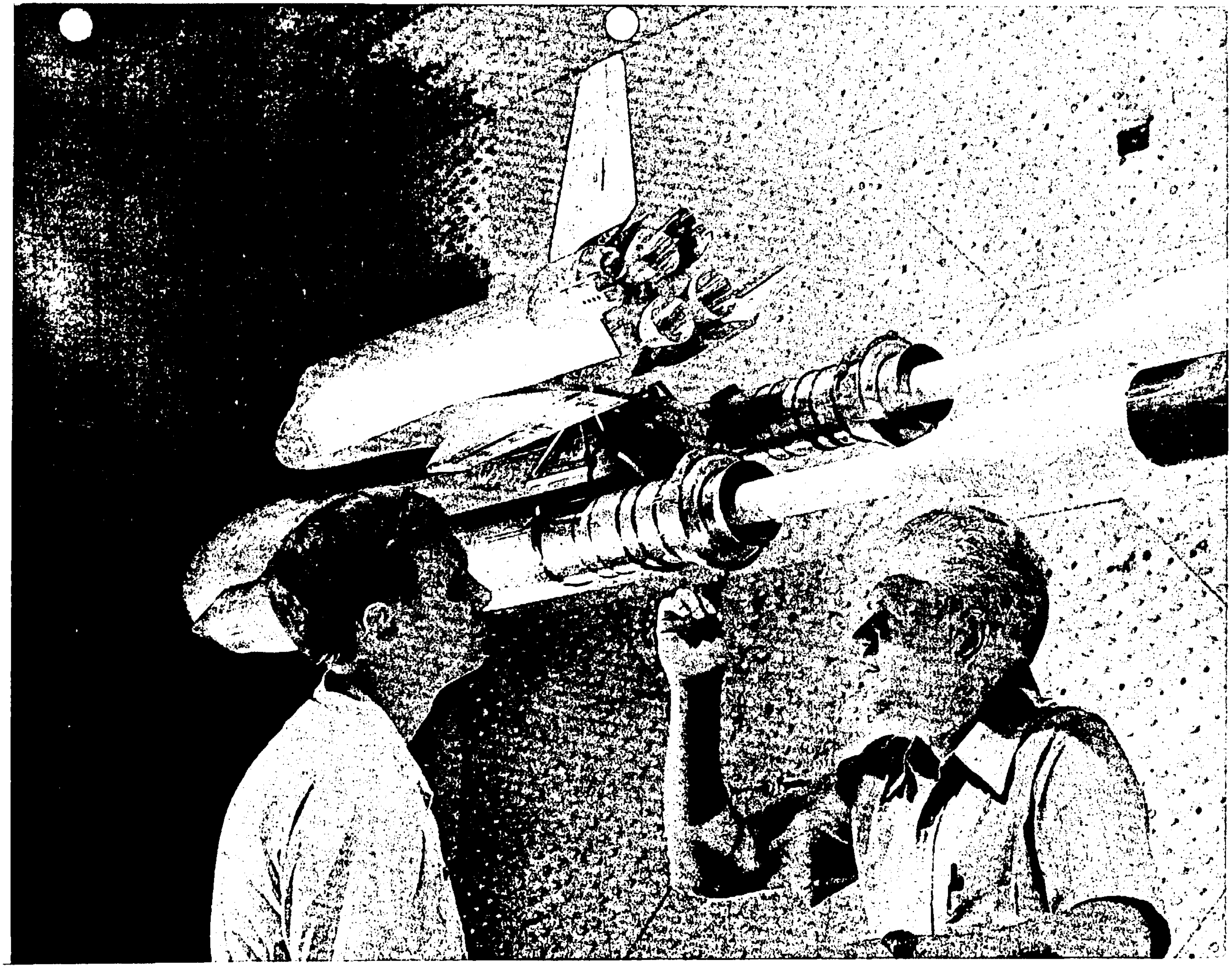
a. First Entry Installation
Figure 11. Model Photographs



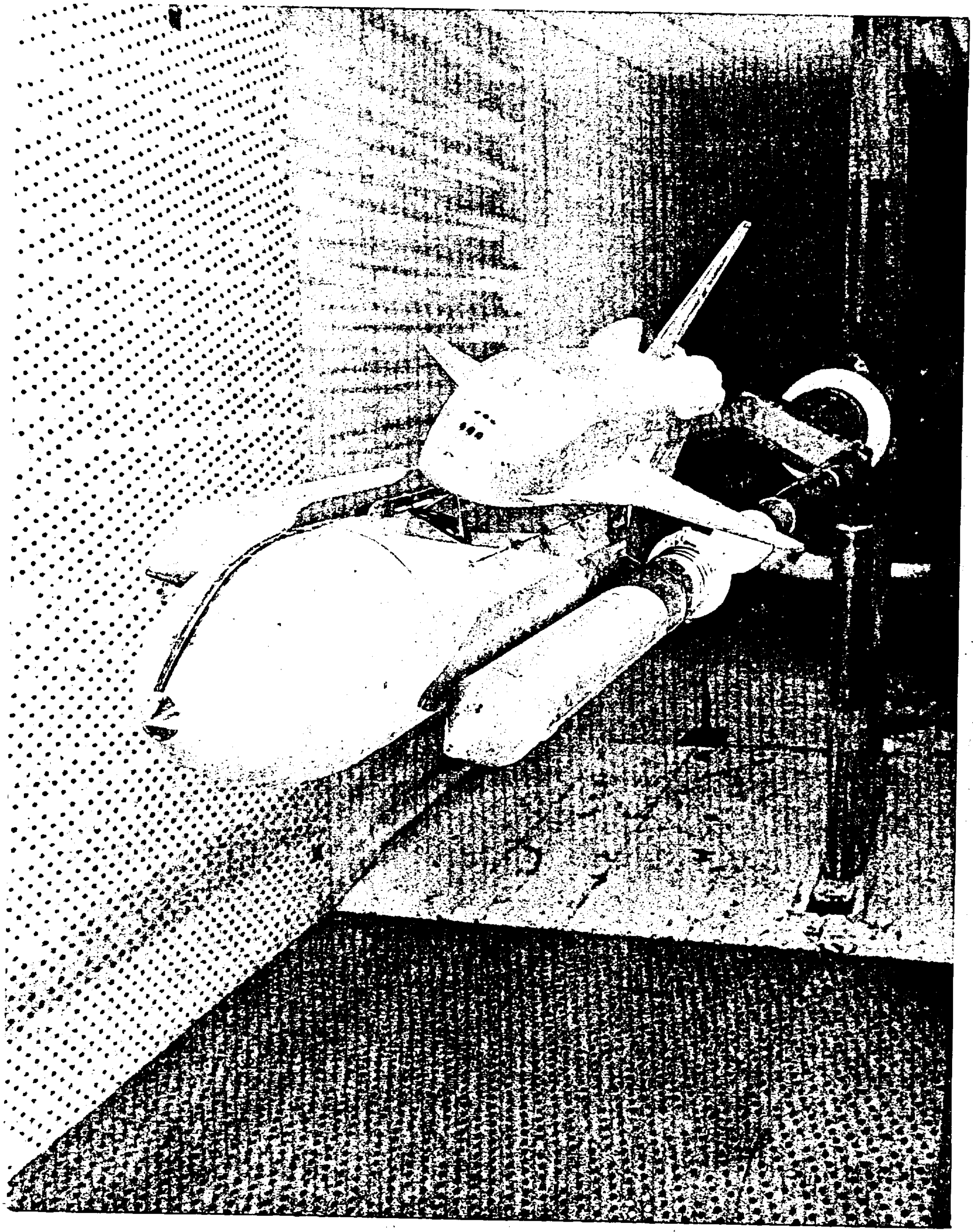
b. Second Entry Installation
Figure 11. Model Photographs



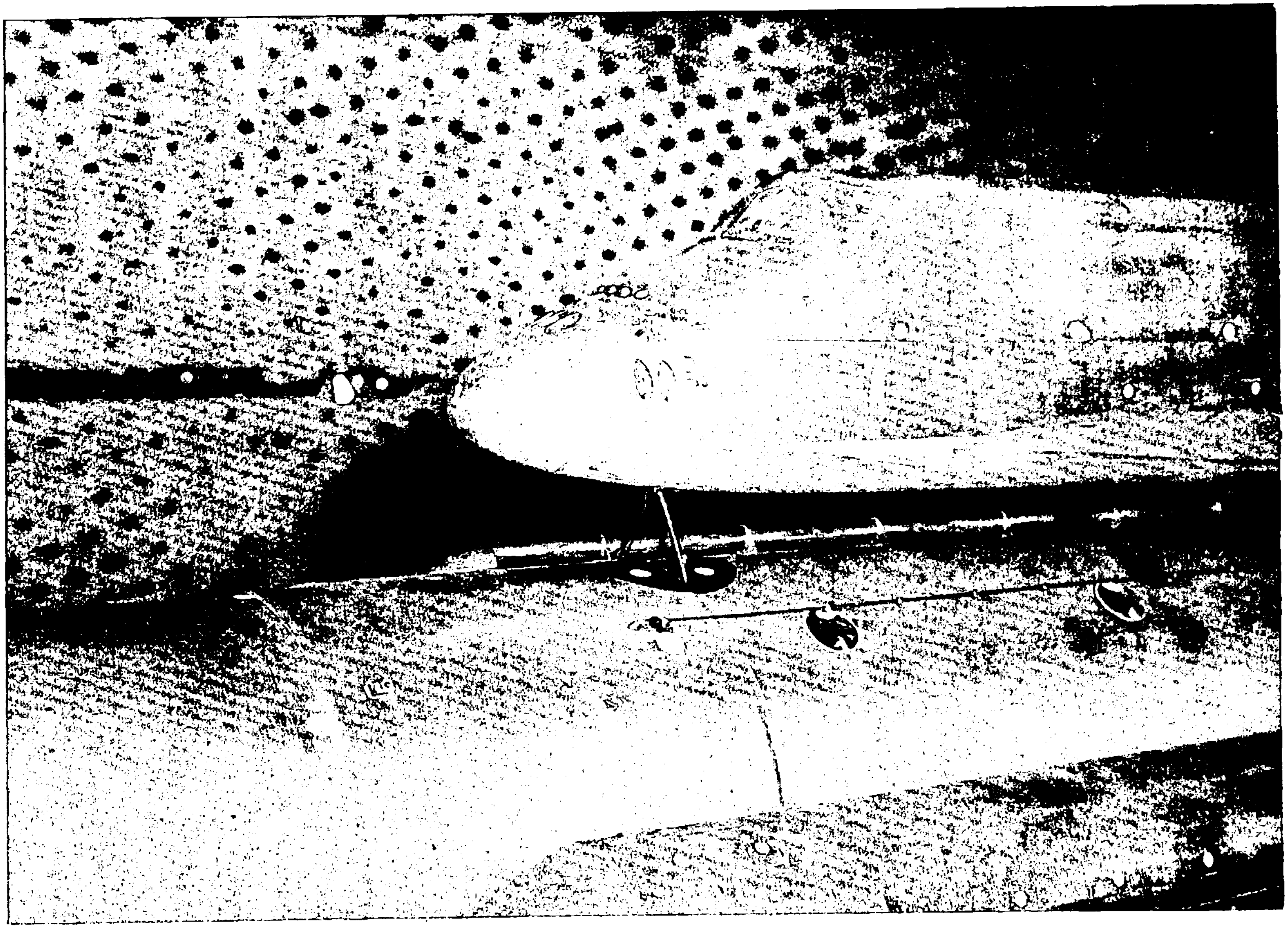
c. Model 47-OTS - Front Quarter View
Figure 11. Model Photographs



d. Model 47-OTS - Rear Quarter View
Figure 11. Model Photographs

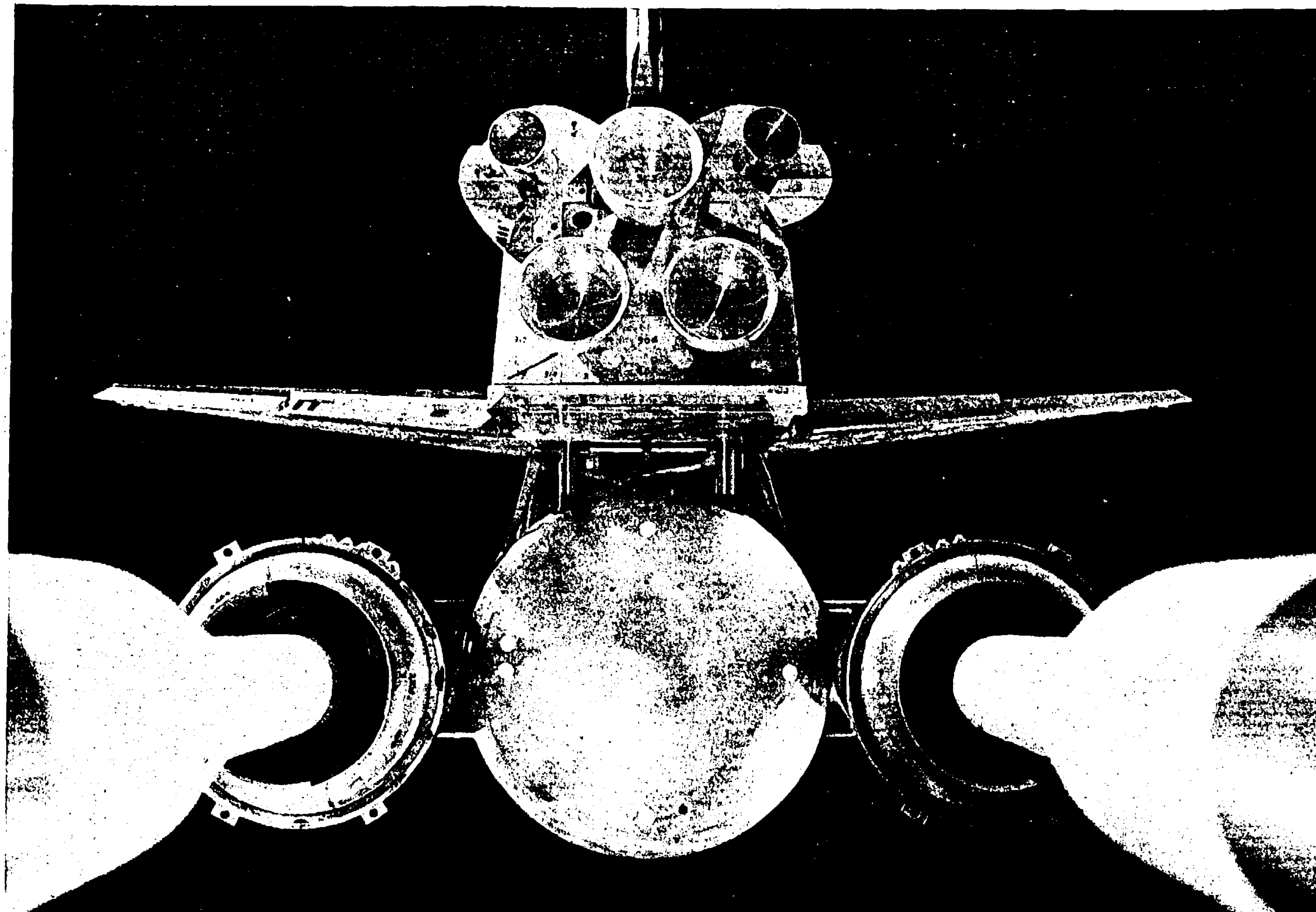


e. Model 47-OTS - Front View
Figure 11. Model Photographs

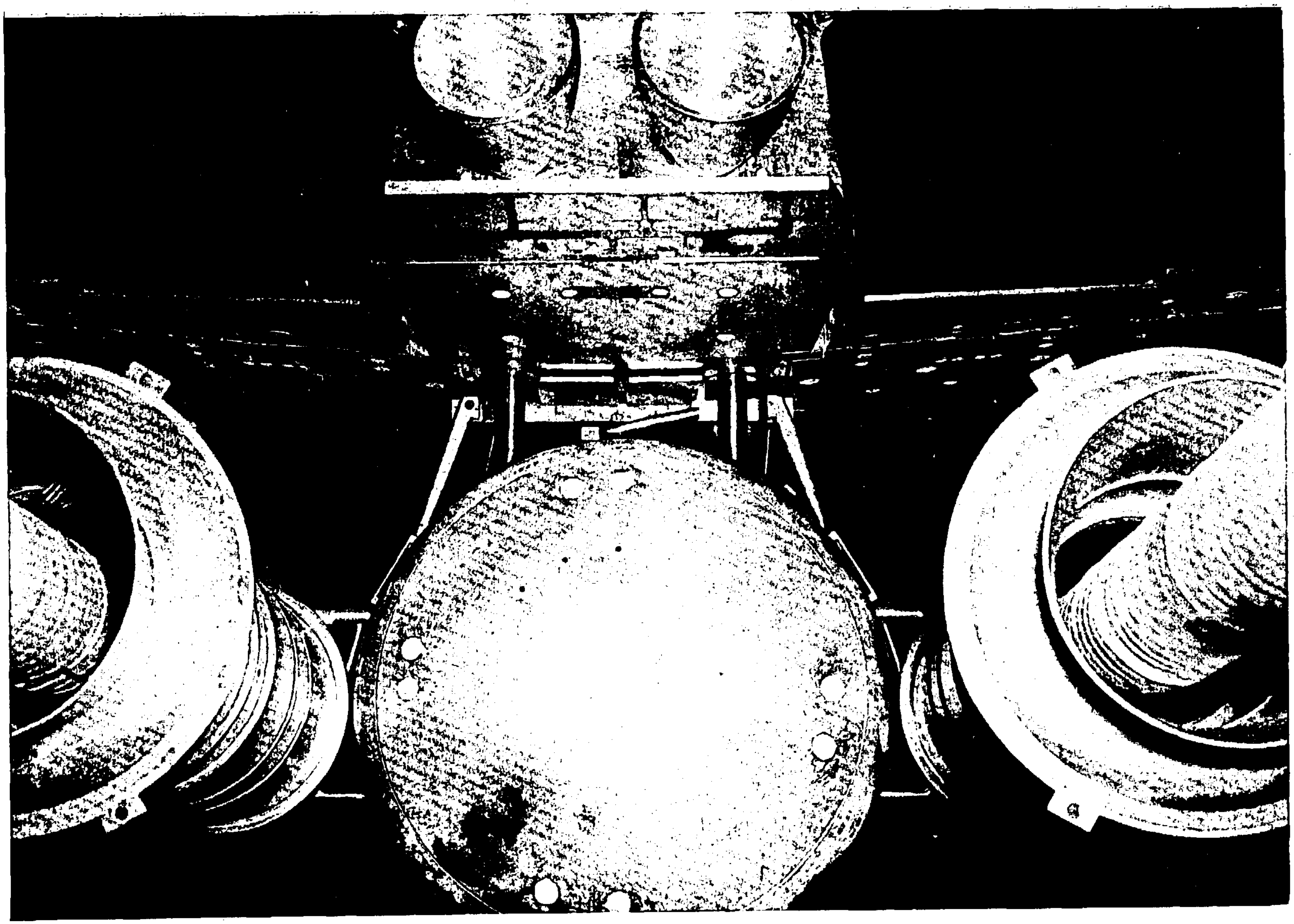


f. Model 47-OTS - Forward Support Detail

Figure 11. Model Photographs



g. Model 47-OTS - Rear View
Figure 11. Model Photographs



h. Model 47-OTS - Aft Attach Structure Detail

Figure 11. Model Photographs

DATA FIGURES

(SAMPLE PRESSURE PLOTS)

Tabulations of plotted data figures may be found in Volumes II and III (microfiche only), or are available from DMS on request.

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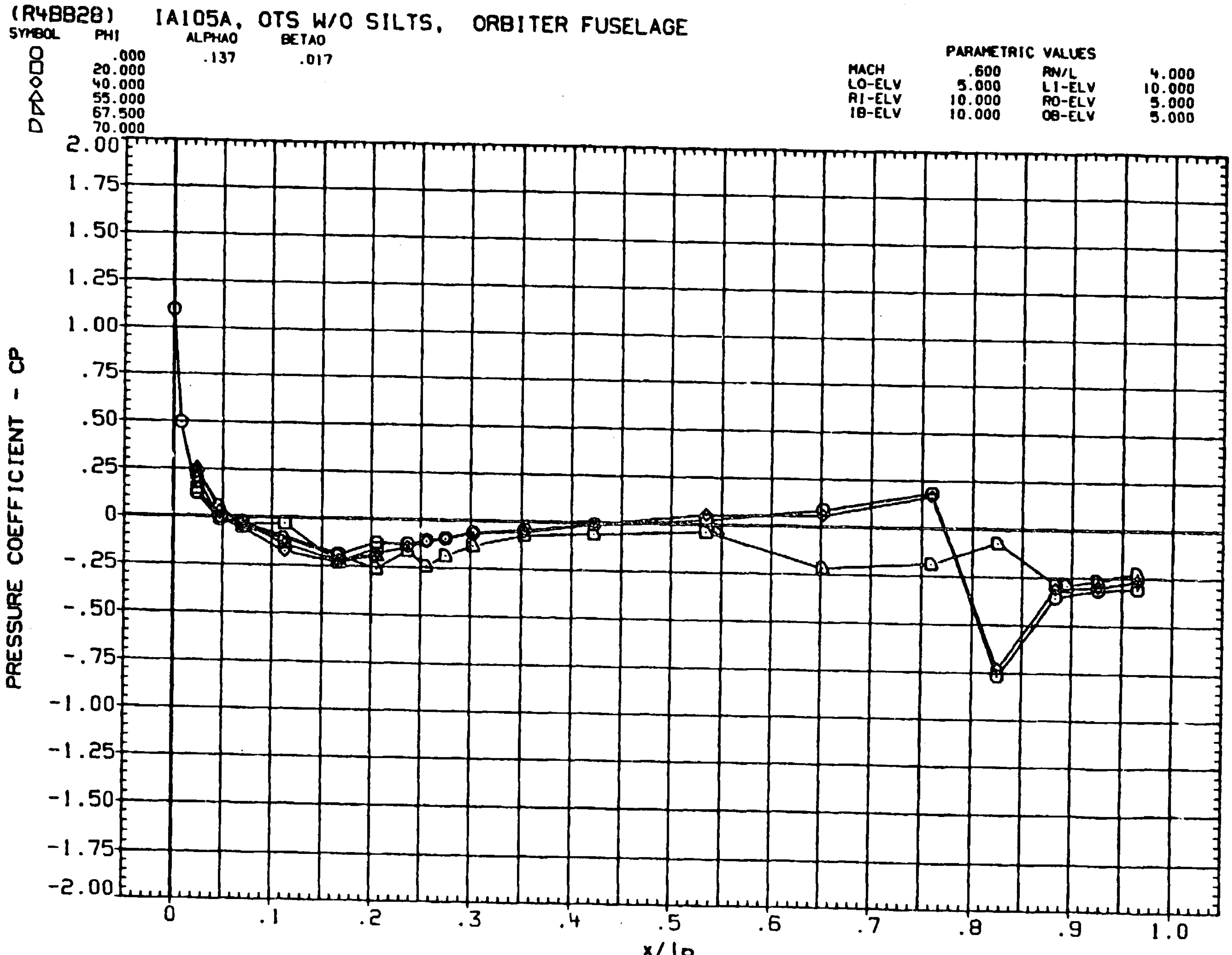

FIGURE 1. TYPICAL PRESSURE DISTRIBUTION - ORBITER FUSELAGE

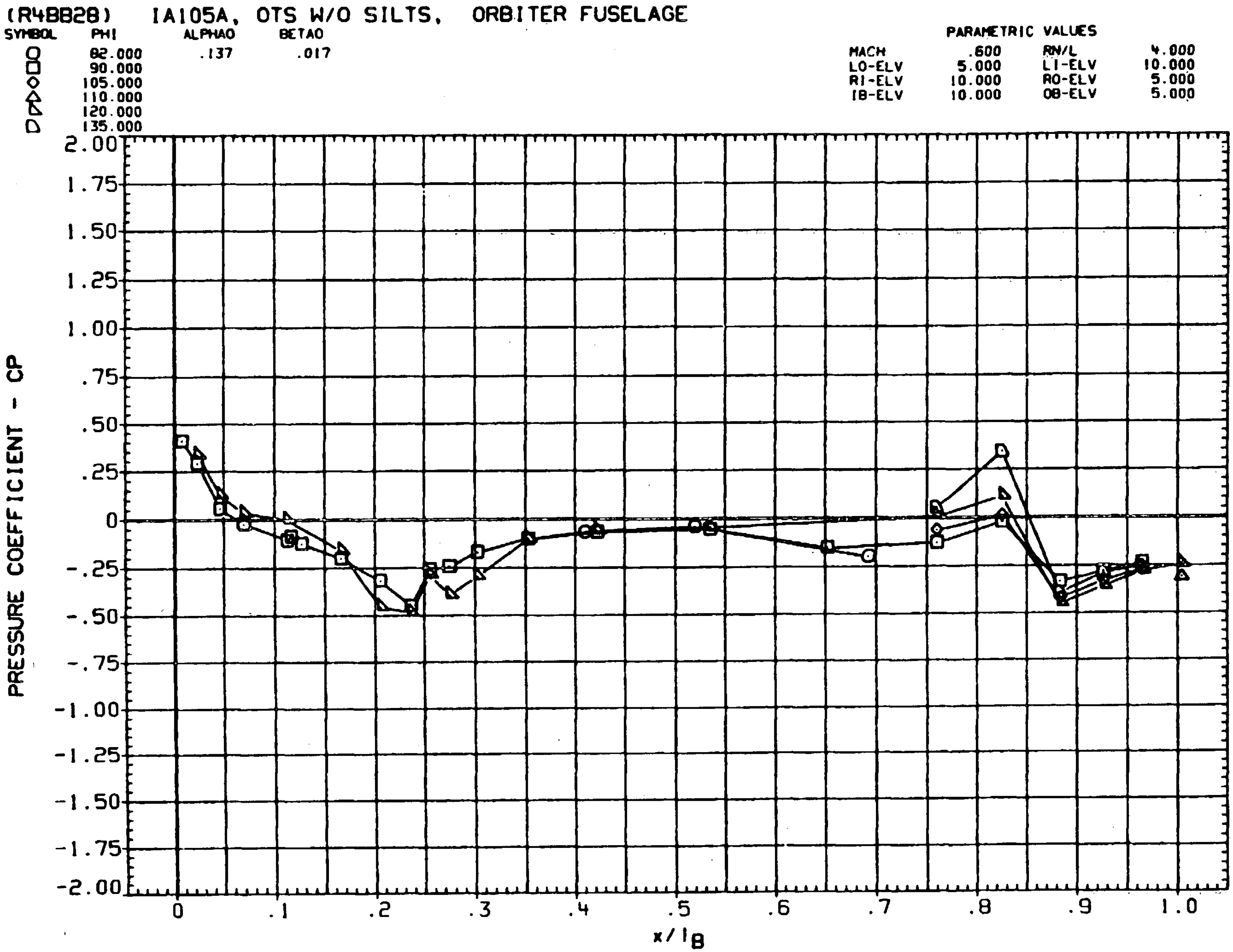

FIGURE 1. TYPICAL PRESSURE DISTRIBUTION - ORBITER FUSELAGE

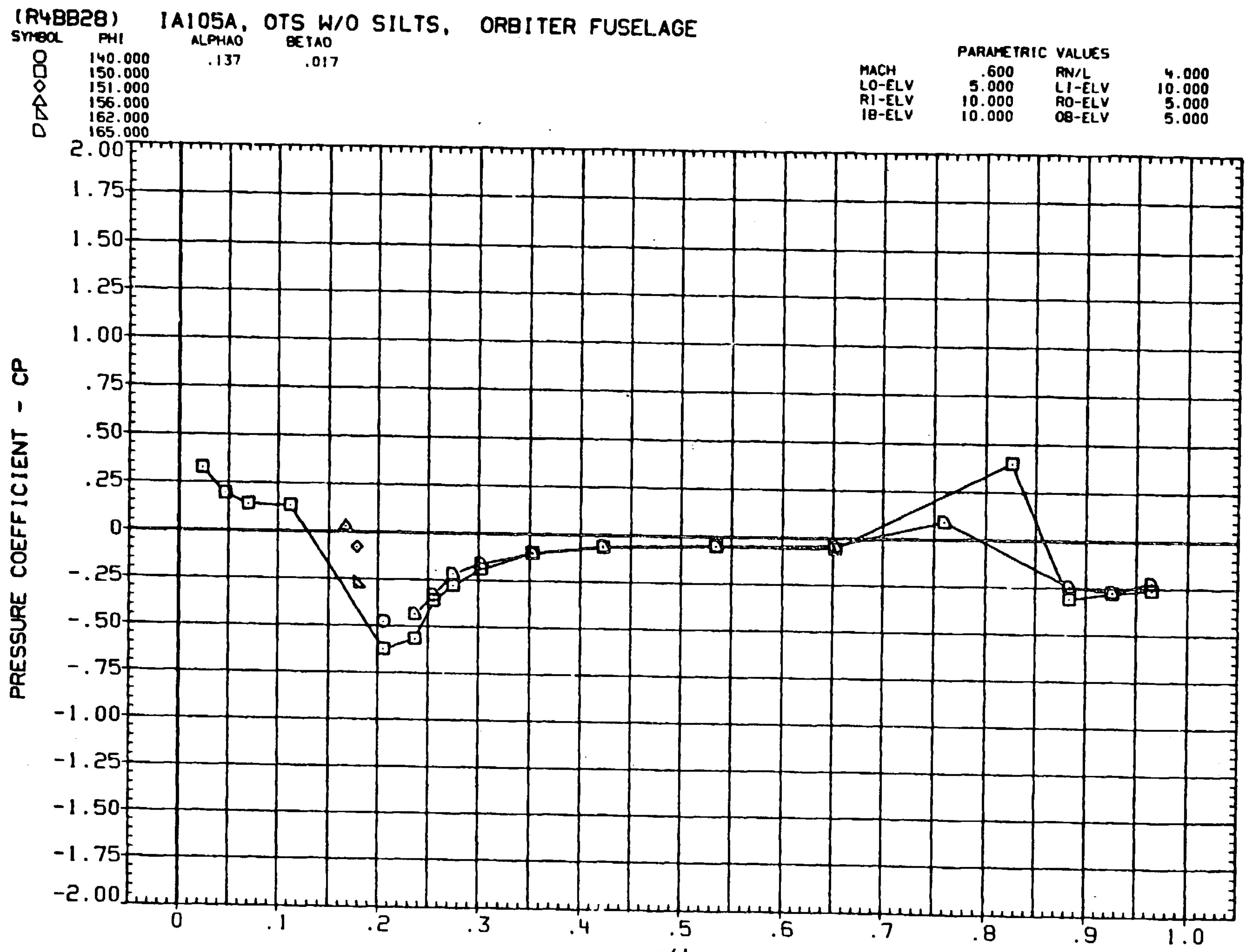

FIGURE 1. TYPICAL PRESSURE DISTRIBUTION - ORBITER FUSELAGE

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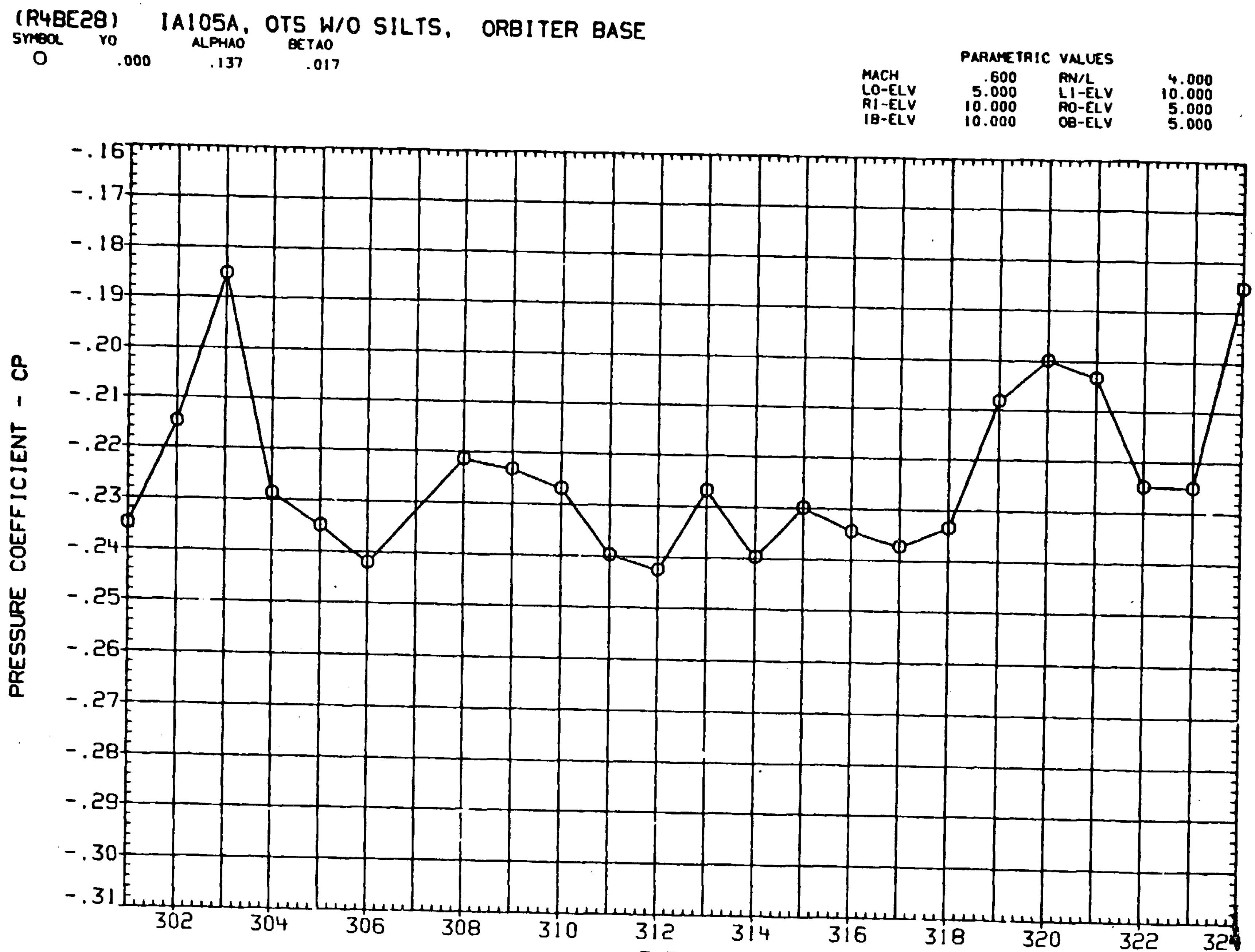

FIGURE 2. TYPICAL PRESSURE DISTRIBUTION - ORBITER BASE

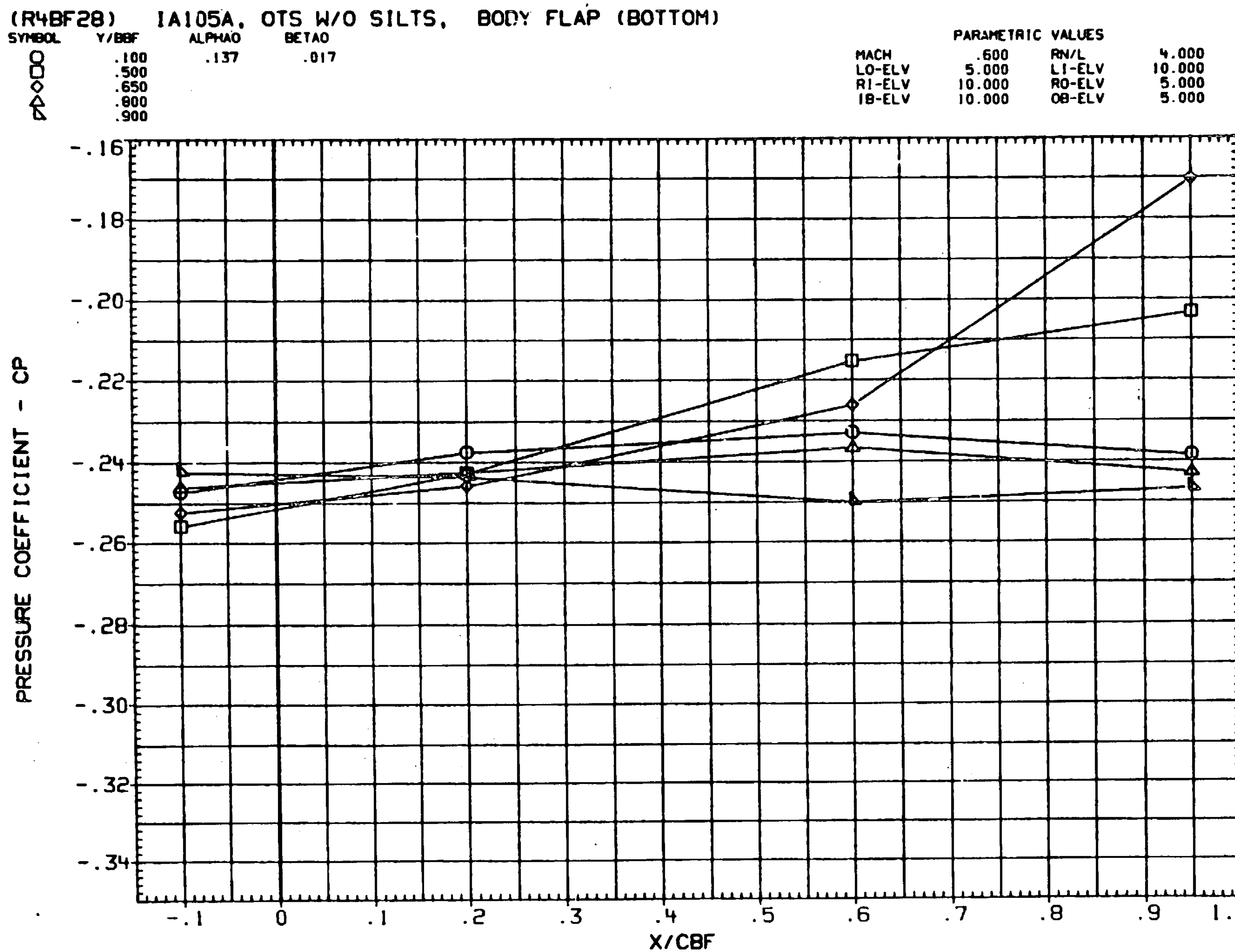

FIGURE 3. TYPICAL PRESSURE DISTRIBUTION - BODY FLAP - LOWER SURFACE

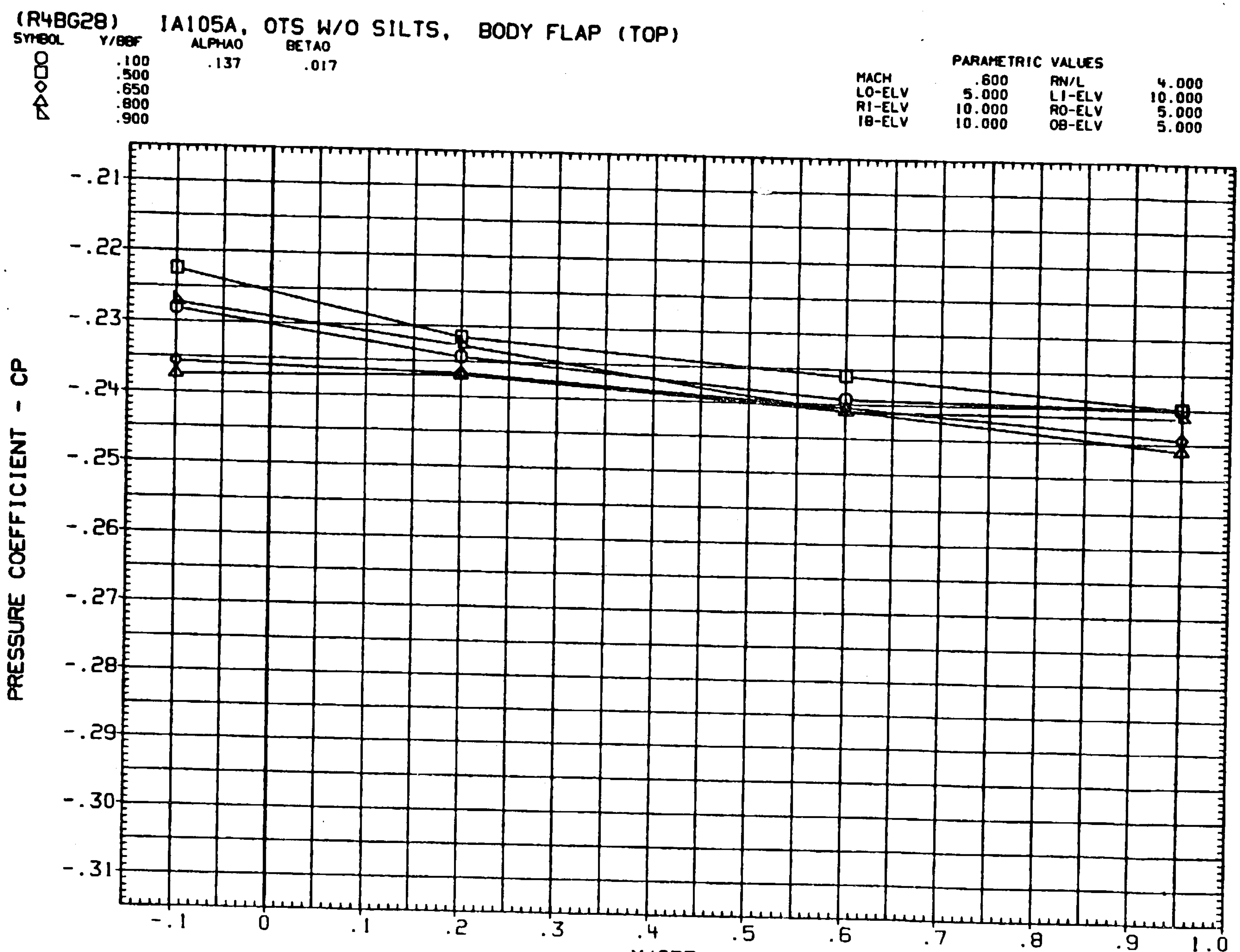

FIGURE 4. TYPICAL PRESSURE DISTRIBUTION - BODY FLAP - UPPER SURFACE

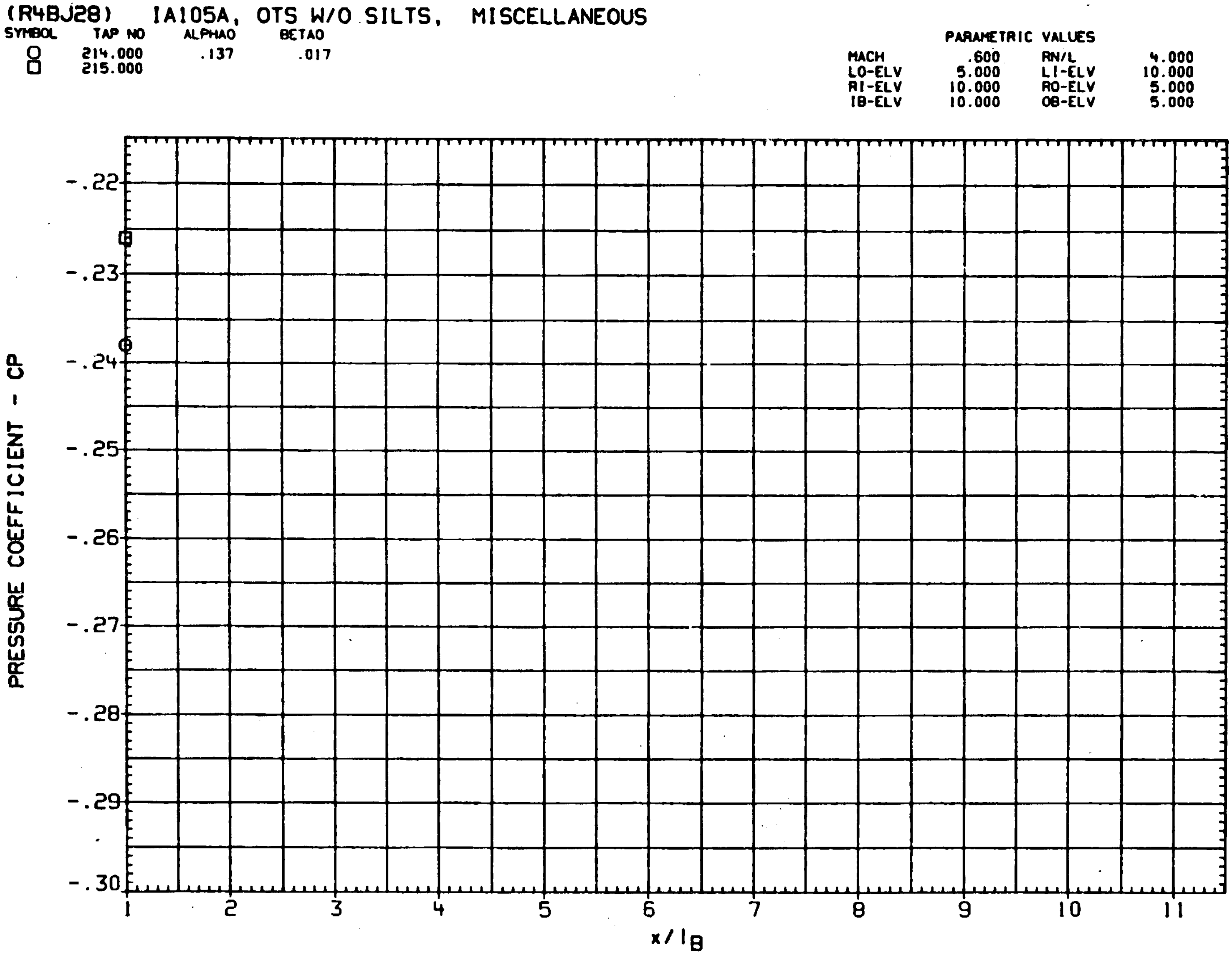

FIGURE 5. TYPICAL PRESSURE DISTRIBUTION - MISCELLANEOUS TAPS

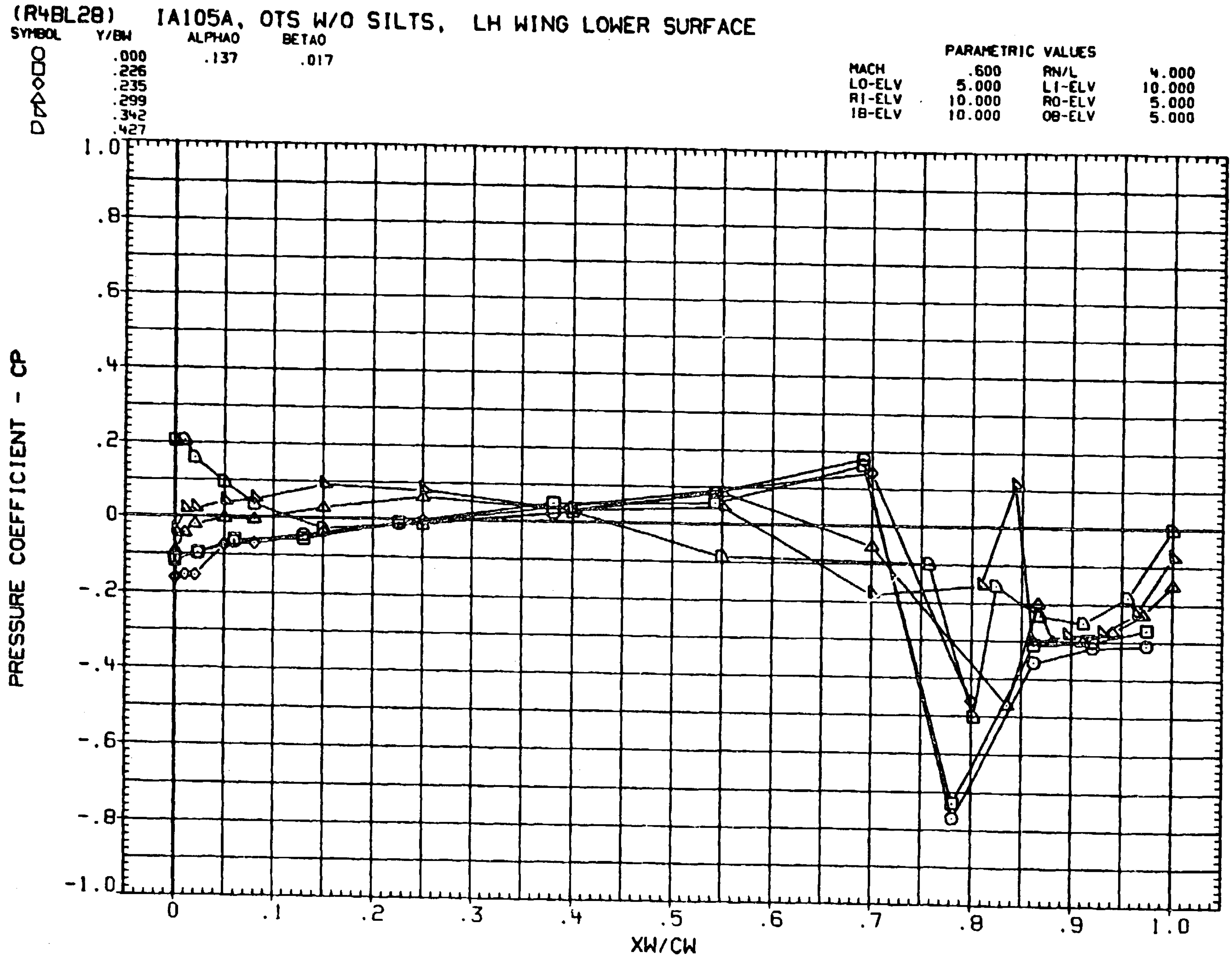

FIGURE 6. TYPICAL PRESSURE DISTRIBUTION - WING - LOWER SURFACE

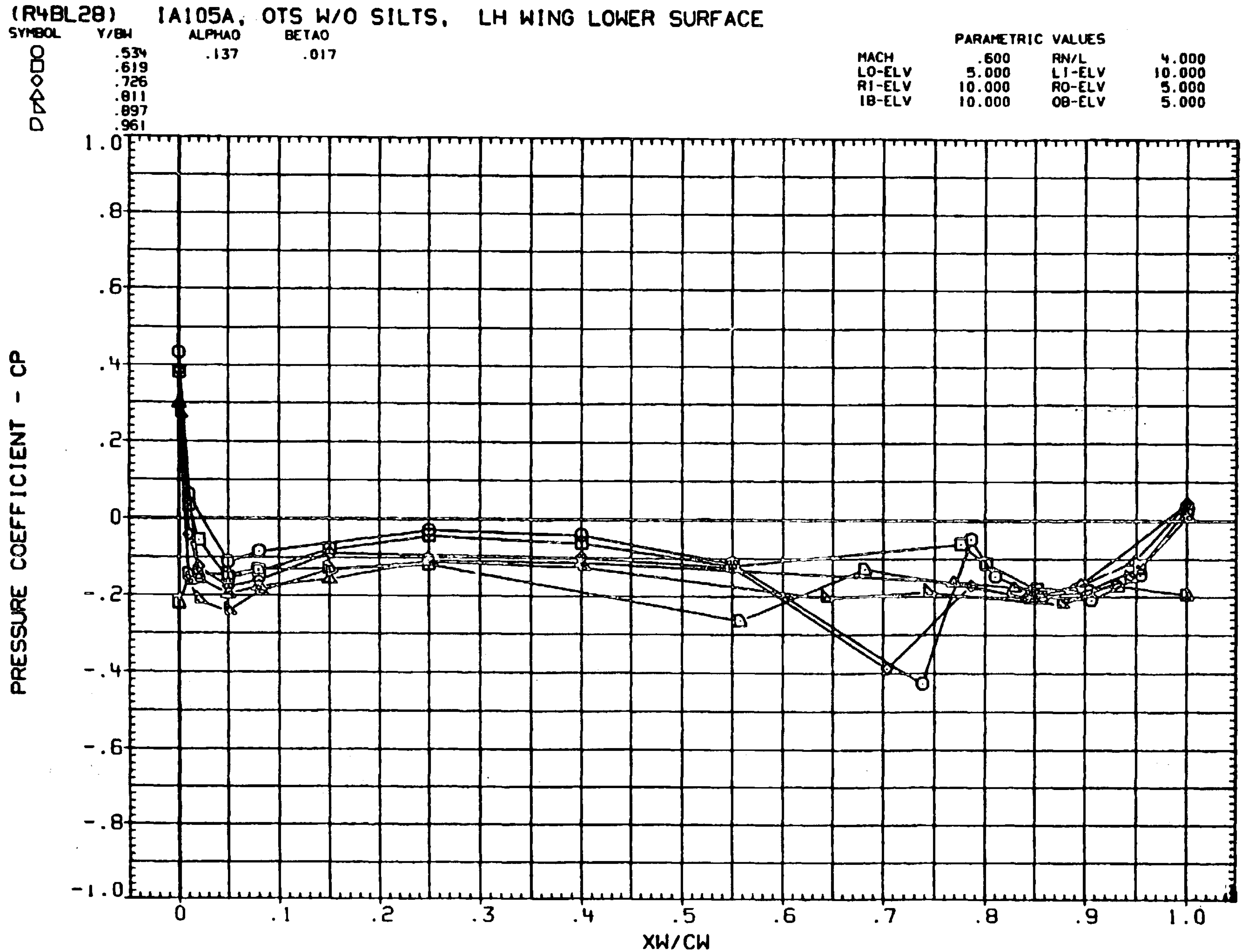

FIGURE 6. TYPICAL PRESSURE DISTRIBUTION - WING - LOWER SURFACE

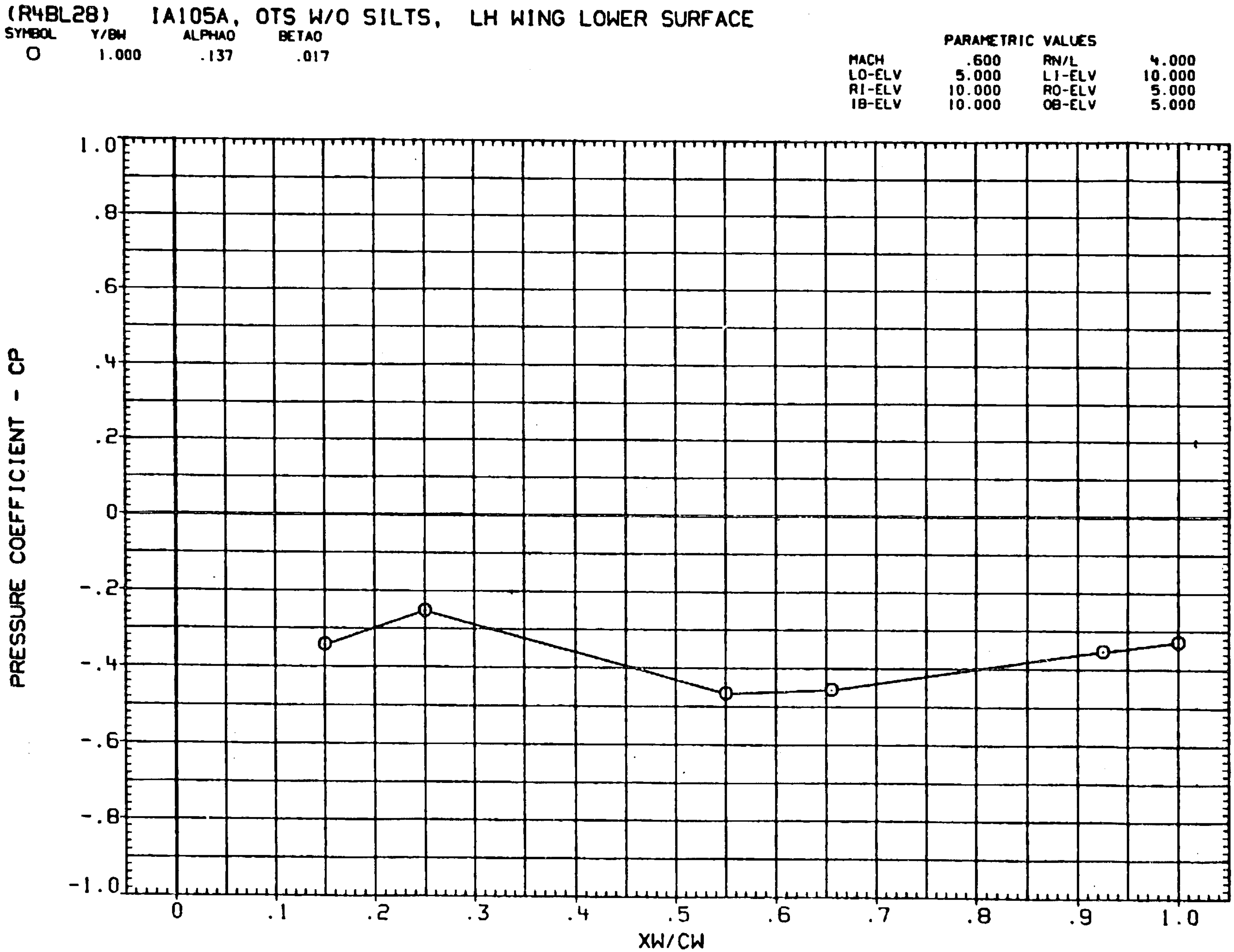

FIGURE 6. TYPICAL PRESSURE DISTRIBUTION - WING - LOWER SURFACE

(R4BM28) IA105A, OTS W/O SILTS, ET PROTUBERANCES

SYMBOL	YO	ALPHAO	BETAO
O	.000	.137	.017

PARAMETRIC VALUES

MACH	.600	RN/L	4.000
LO-ELV	5.000	LI-ELV	10.000
RI-ELV	10.000	RO-ELV	5.000
IB-ELV	10.000	OB-ELV	5.000

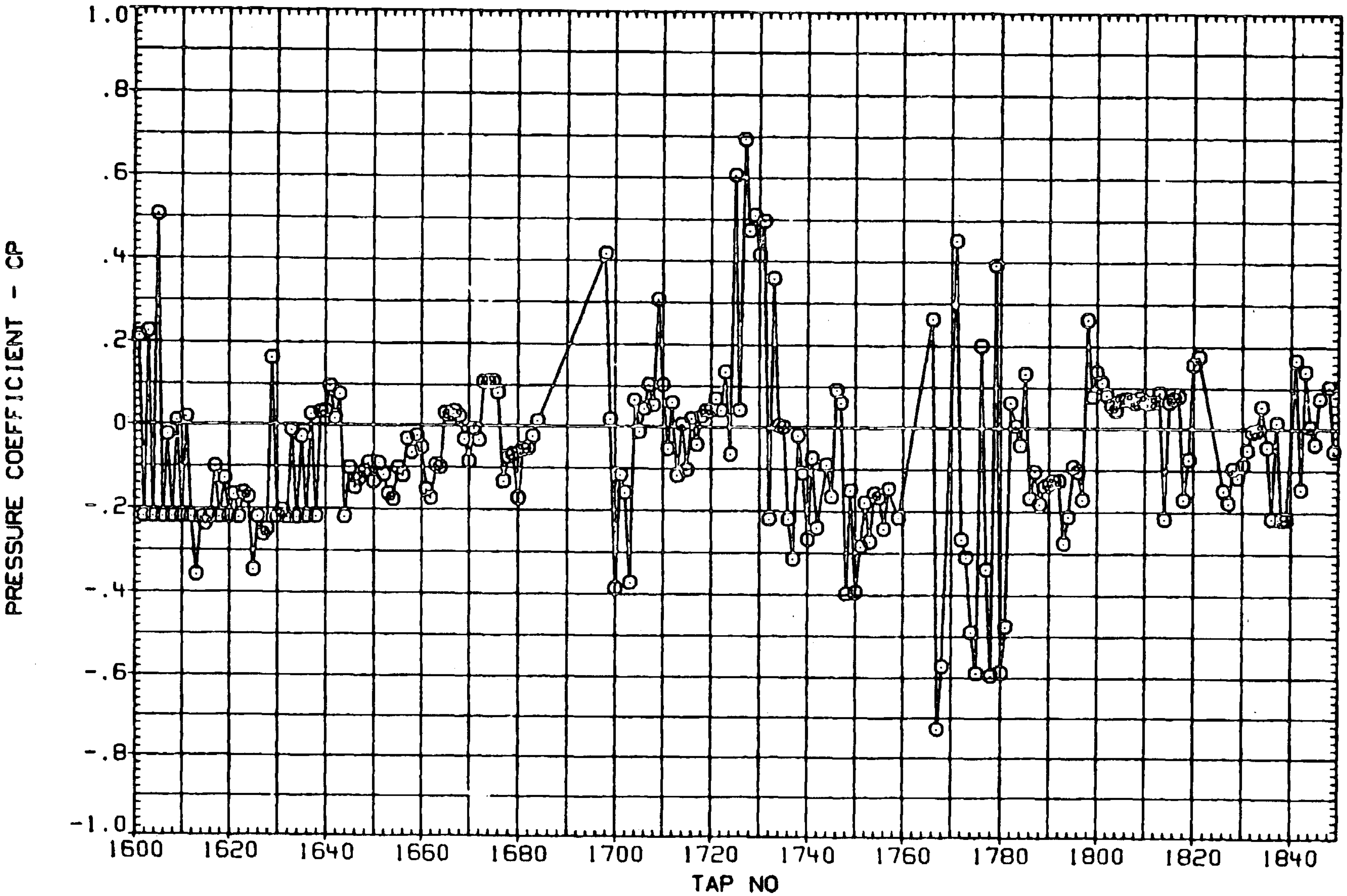

FIGURE 7. TYPICAL PRESSURE DISTRIBUTION - ET PROTUBERANCES

(R4BN28) IA105A, OTS W/O SILTS, SRB PROTUBERANCES

SYMBOL	YO	ALFHAO	BETAO
O	.000	.137	.017

PARAMETRIC VALUES

MACH	.600	RN/L	4.000
LO-ELV	5.000	LI-ELV	10.000
RI-ELV	10.000	RO-ELV	5.000
IB-ELV	10.000	OB-ELV	5.000

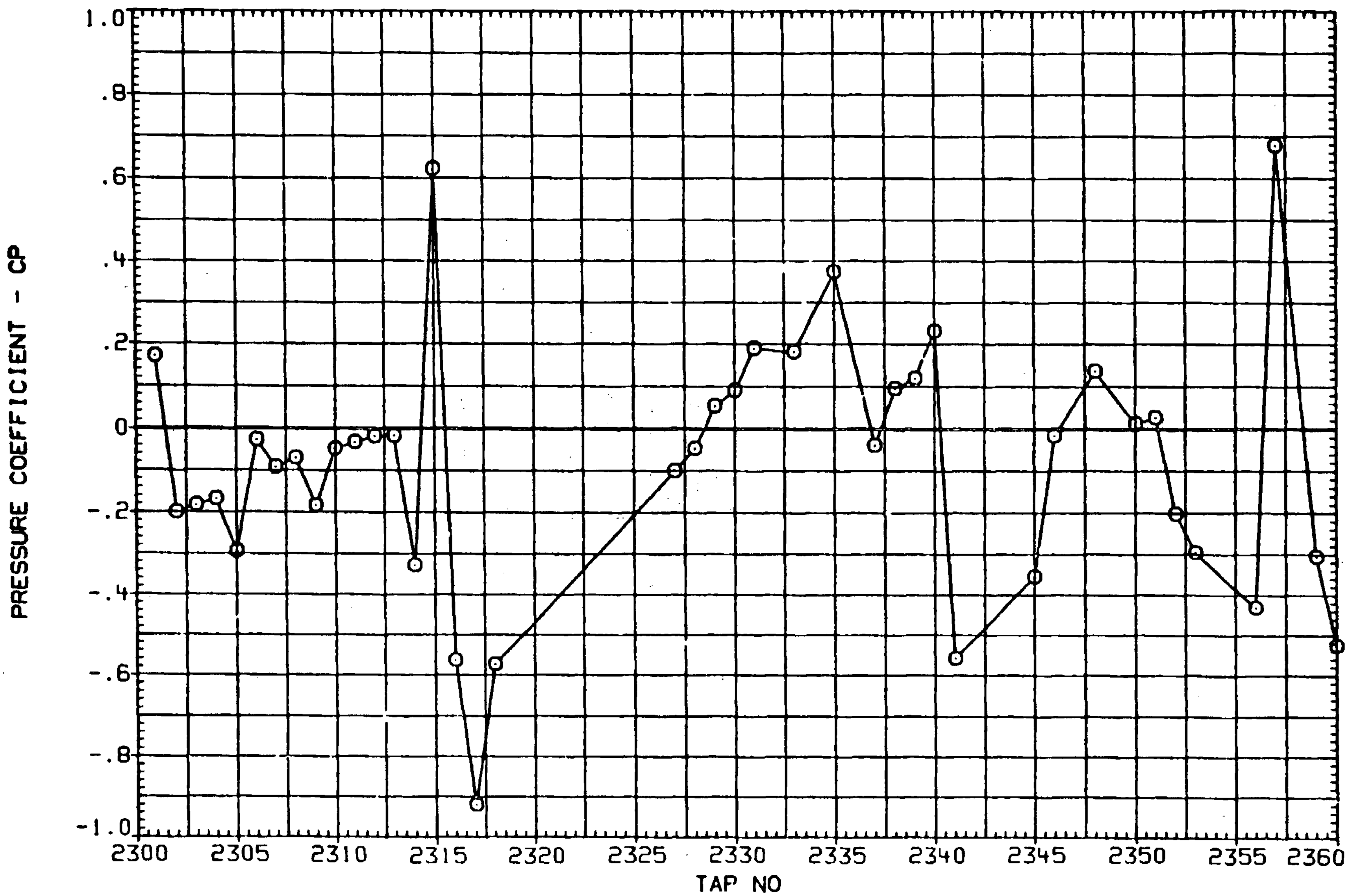

FIGURE 8. TYPICAL PRESSURE DISTRIBUTION - SRB PROTUBERANCES

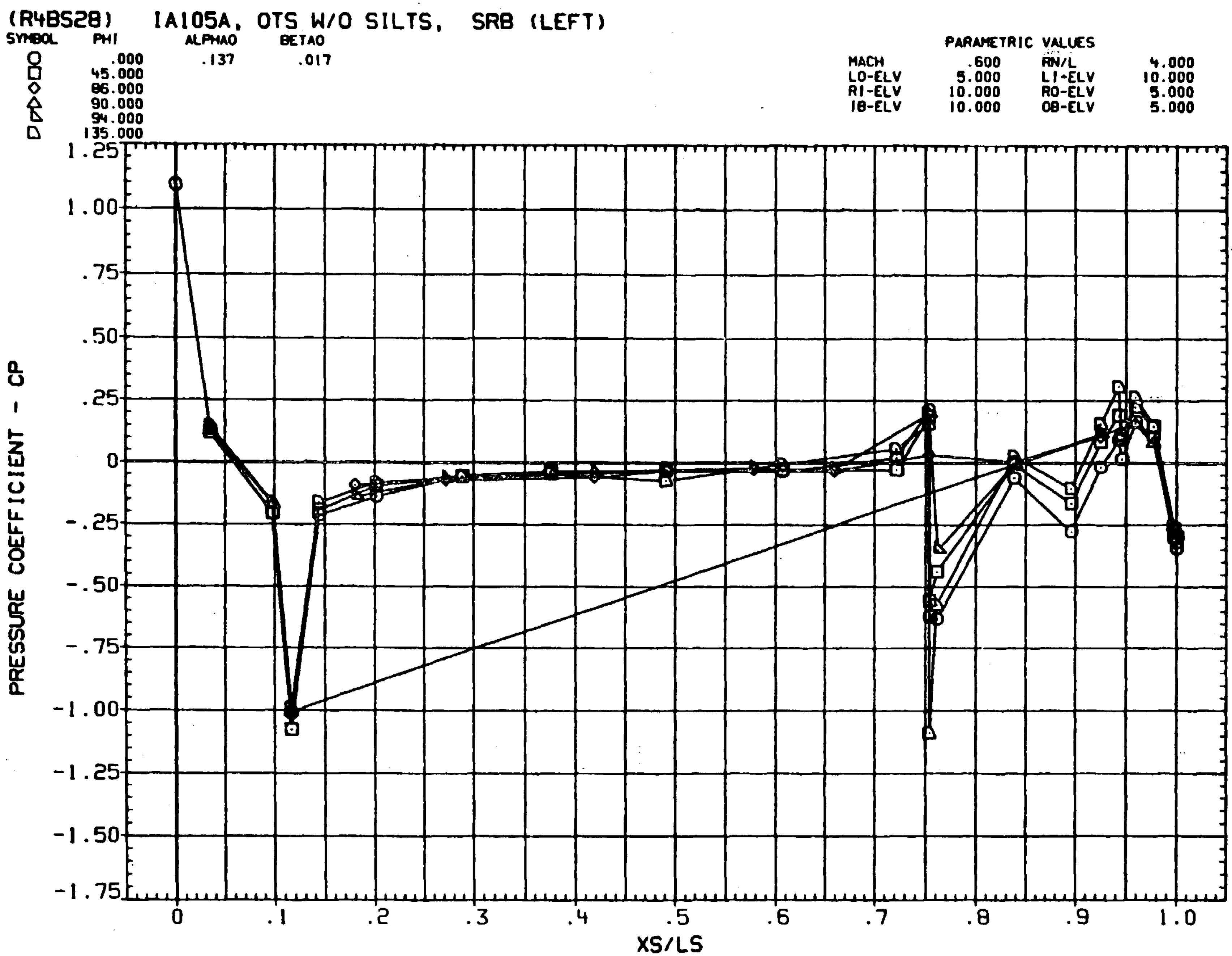

FIGURE 9. TYPICAL PRESSURE DISTRIBUTION - SRB SURFACE

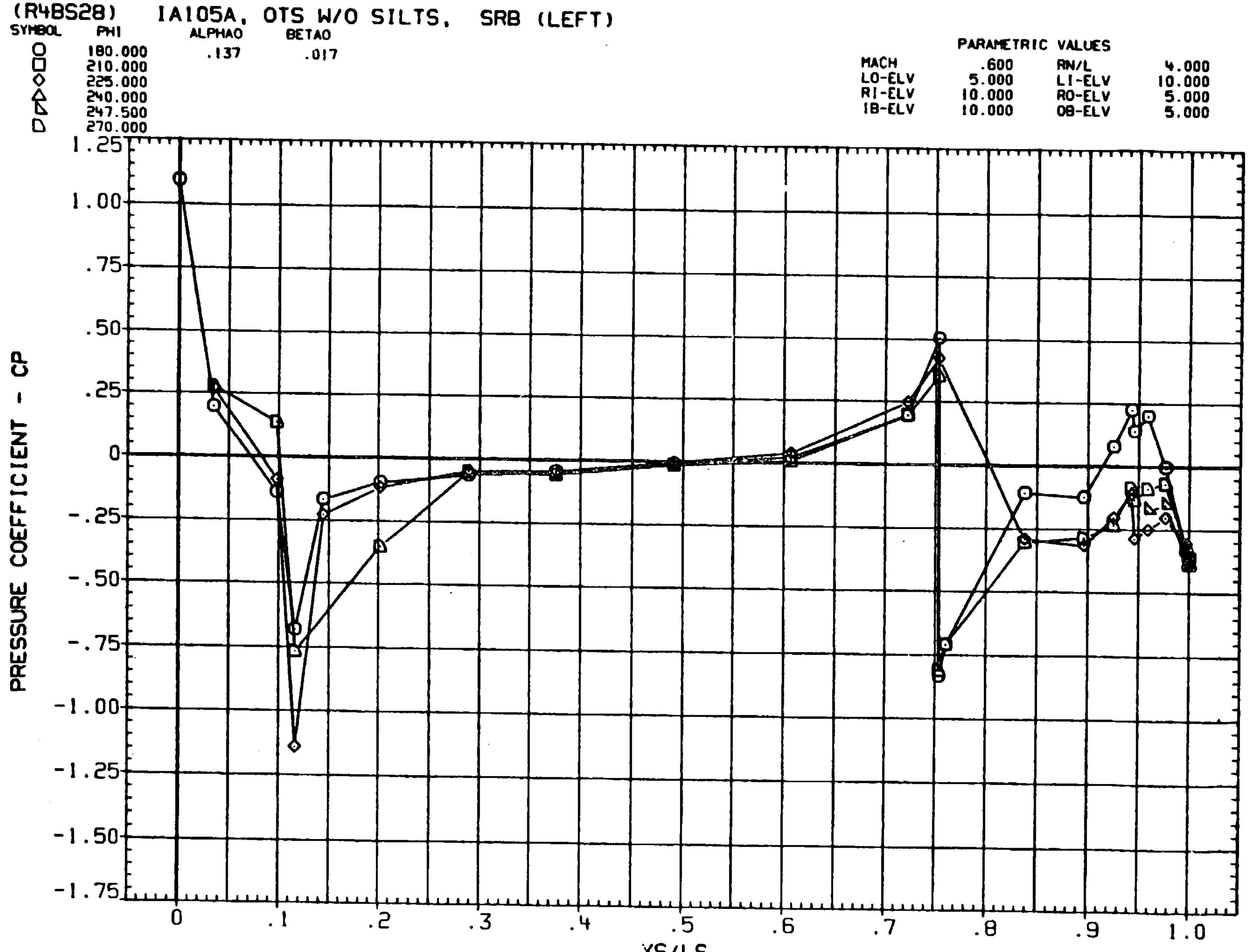

FIGURE 9. TYPICAL PRESSURE DISTRIBUTION - SRB SURFACE

(R4BS28) IA105A, OTS W/O SILTS, SRB (LEFT)

SYMBOL	PHI	ALPHAO	BETAO
○	292.500	.137	.017
□	300.000		
◇	315.000		
△	330.000		

PARAMETRIC VALUES

MACH	.600	RN/L	4.000
LO-ELV	5.000	LI-ELV	10.000
RI-ELV	10.000	RO-ELV	5.000
IB-ELV	10.000	OB-ELV	5.000

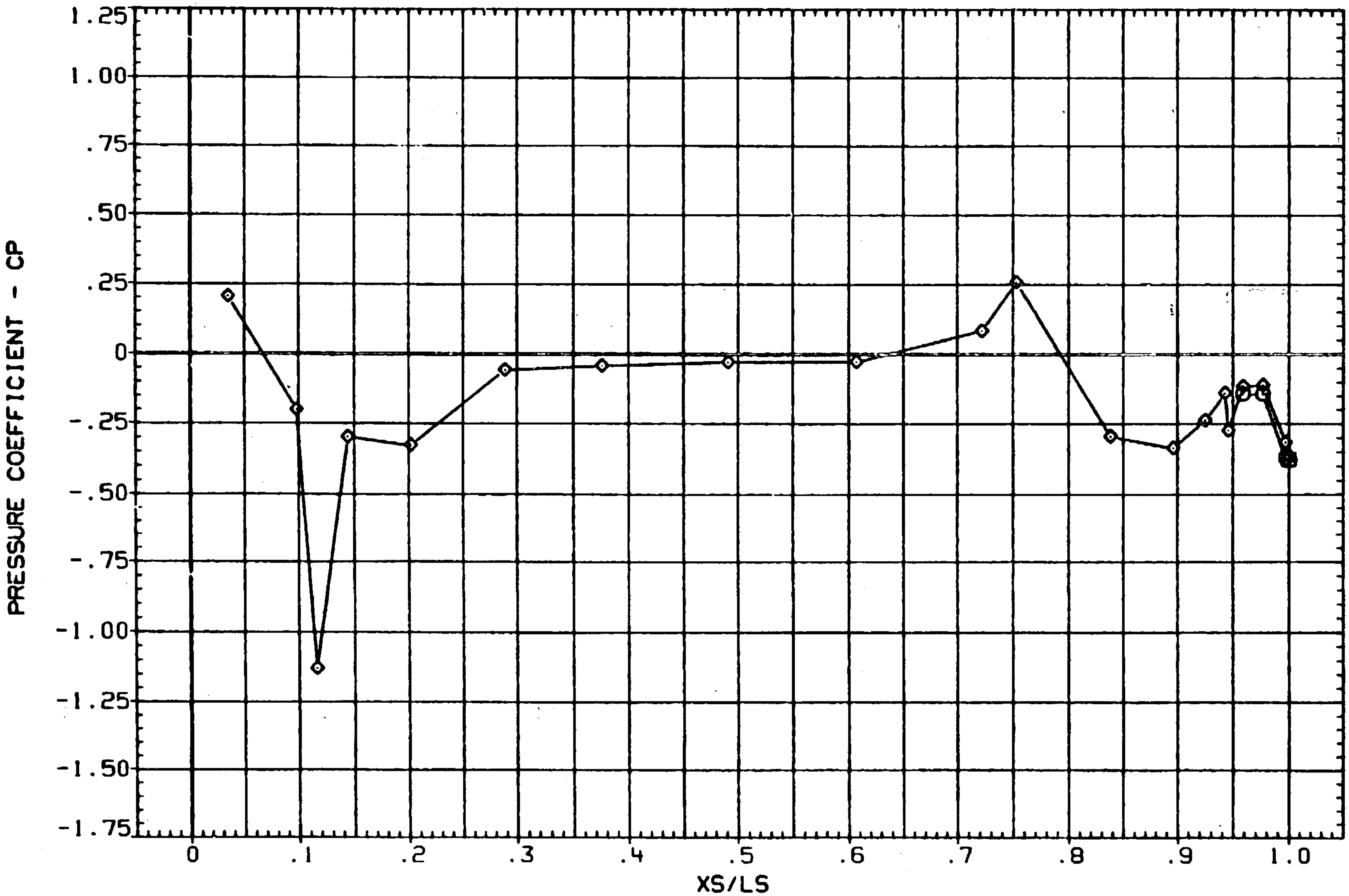

FIGURE 9. TYPICAL PRESSURE DISTRIBUTION - SRB SURFACE

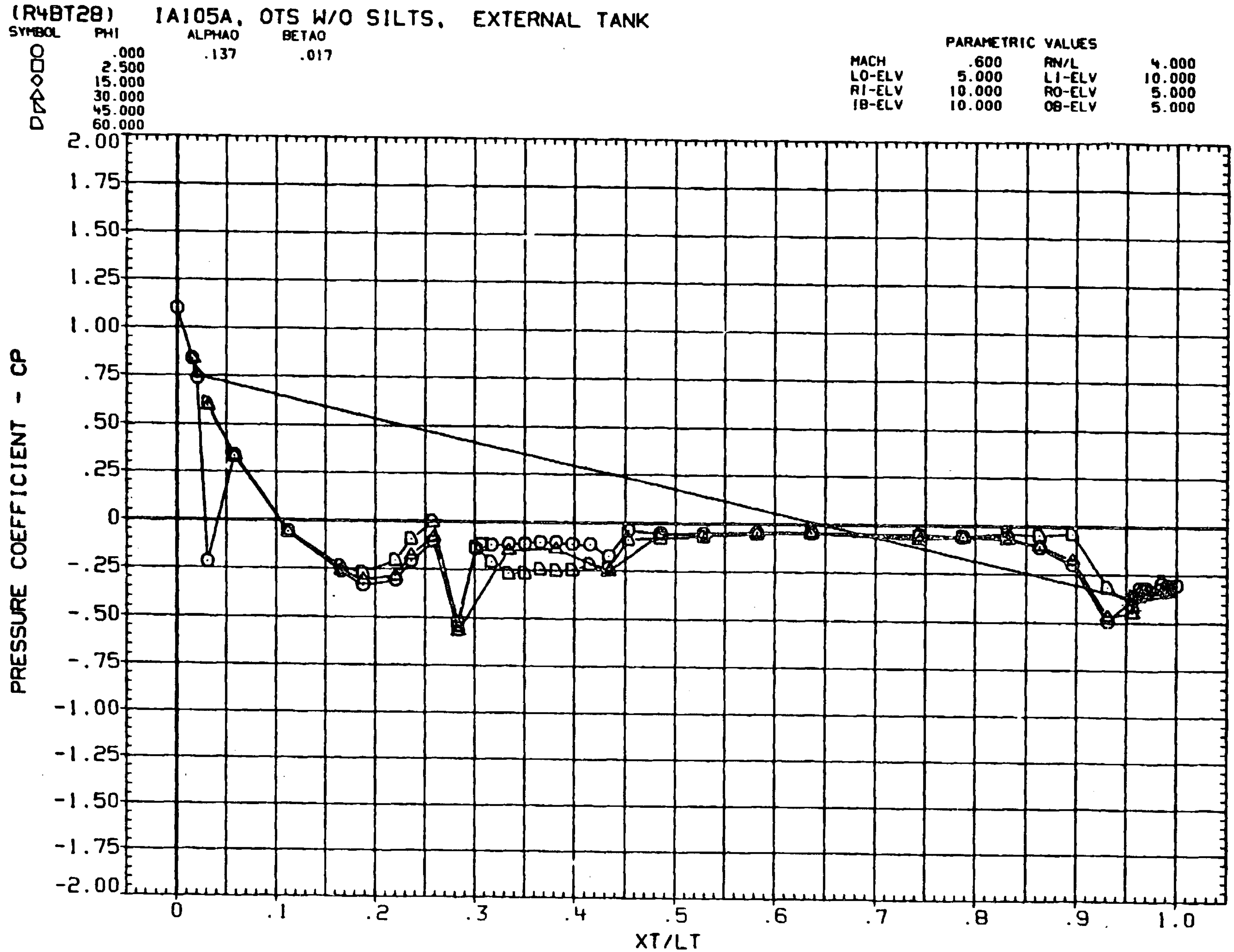

FIGURE 10. TYPICAL PRESSURE DISTRIBUTION - ET SURFACE

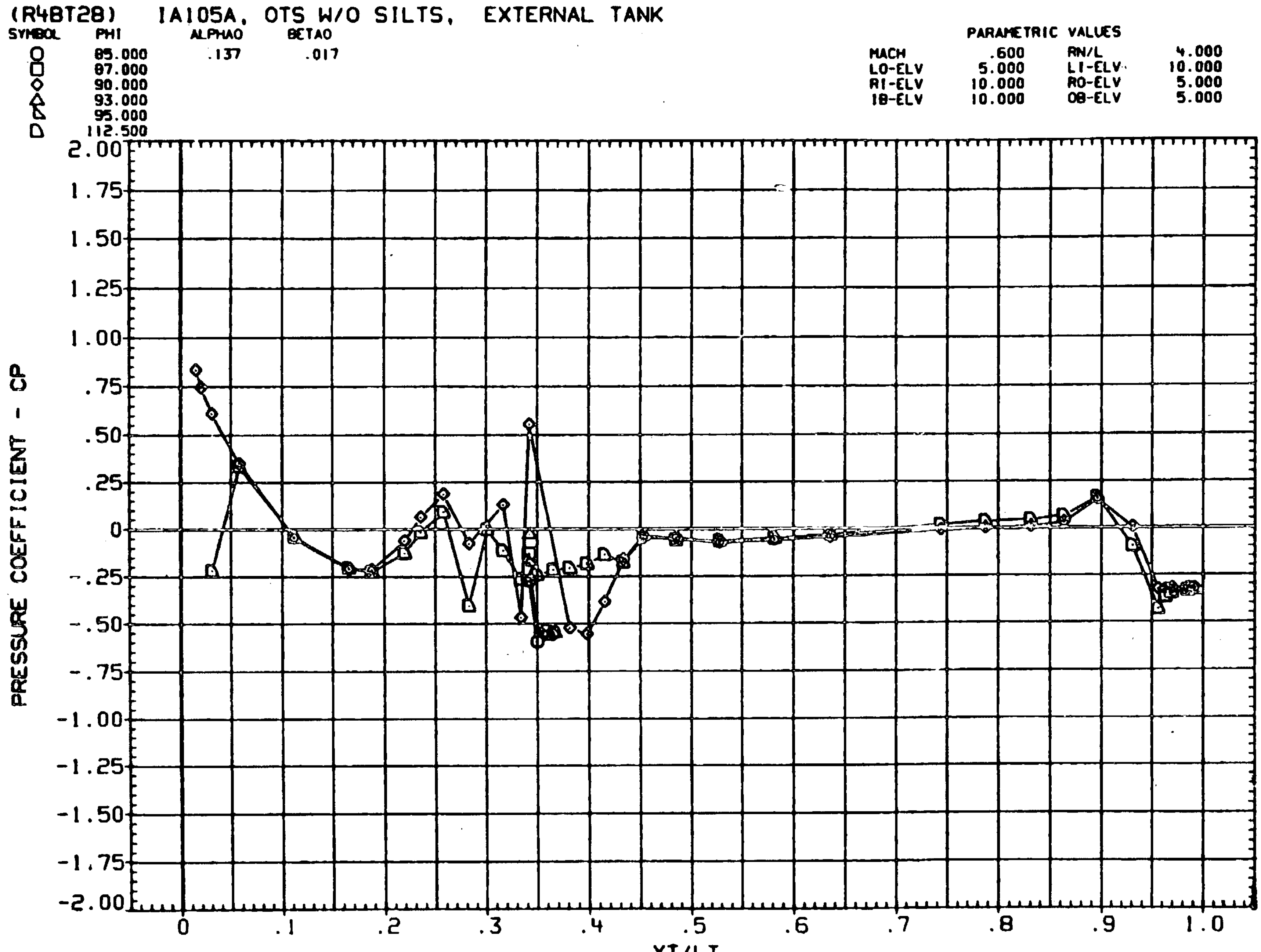

FIGURE 10. TYPICAL PRESSURE DISTRIBUTION - ET SURFACE

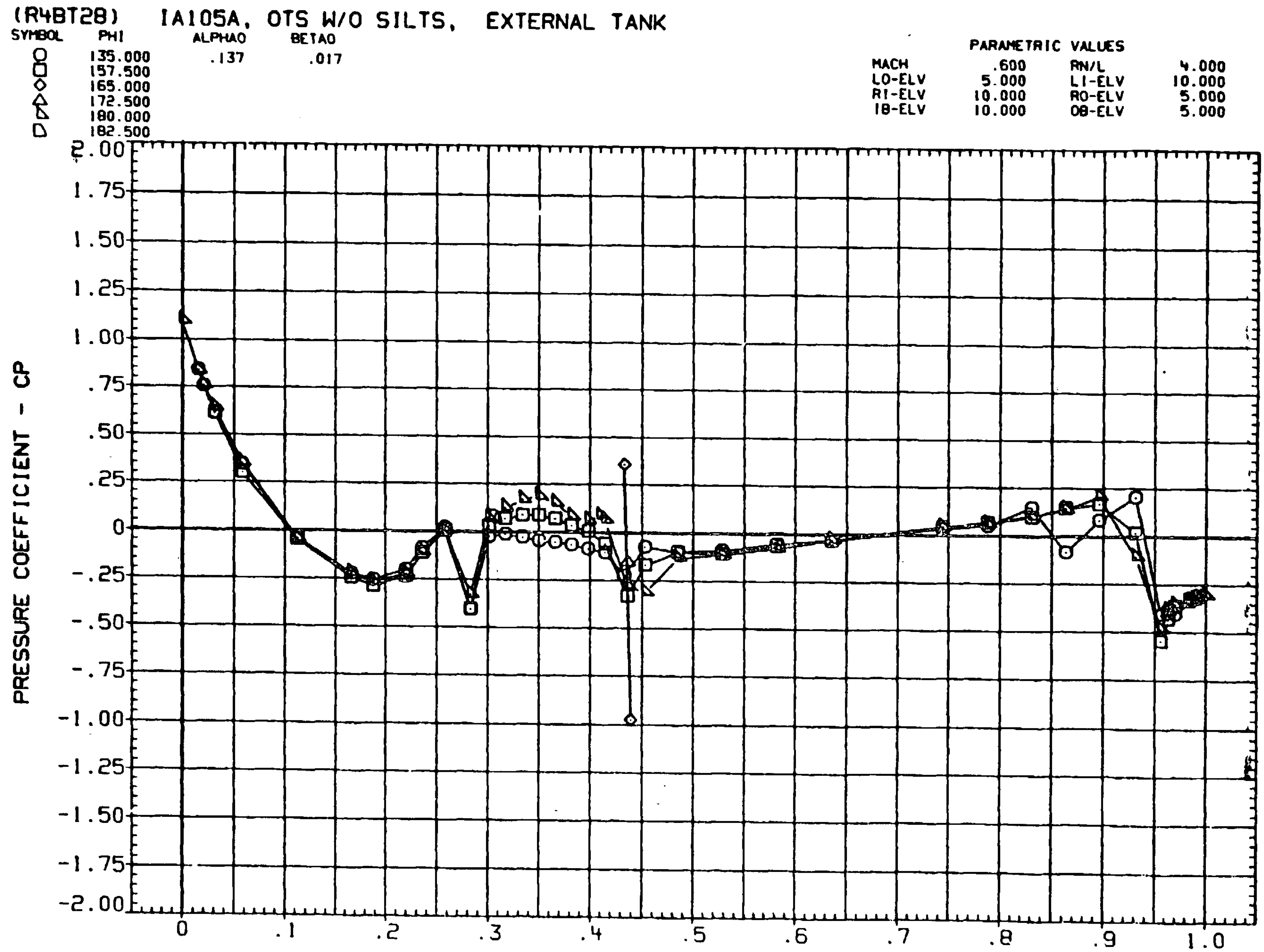

FIGURE 10. TYPICAL PRESSURE DISTRIBUTION - ET SURFACE

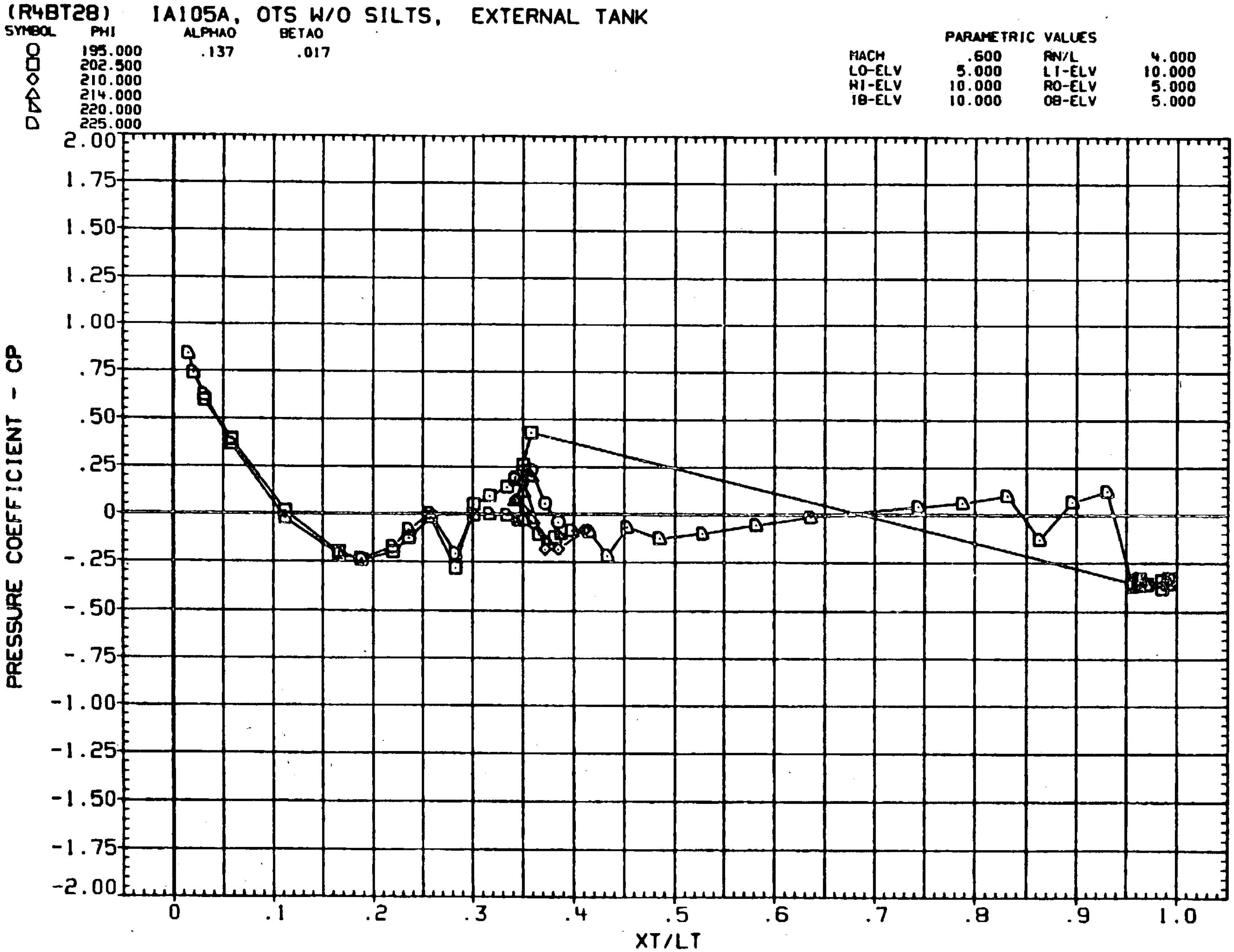

FIGURE 10. TYPICAL PRESSURE DISTRIBUTION - ET SURFACE

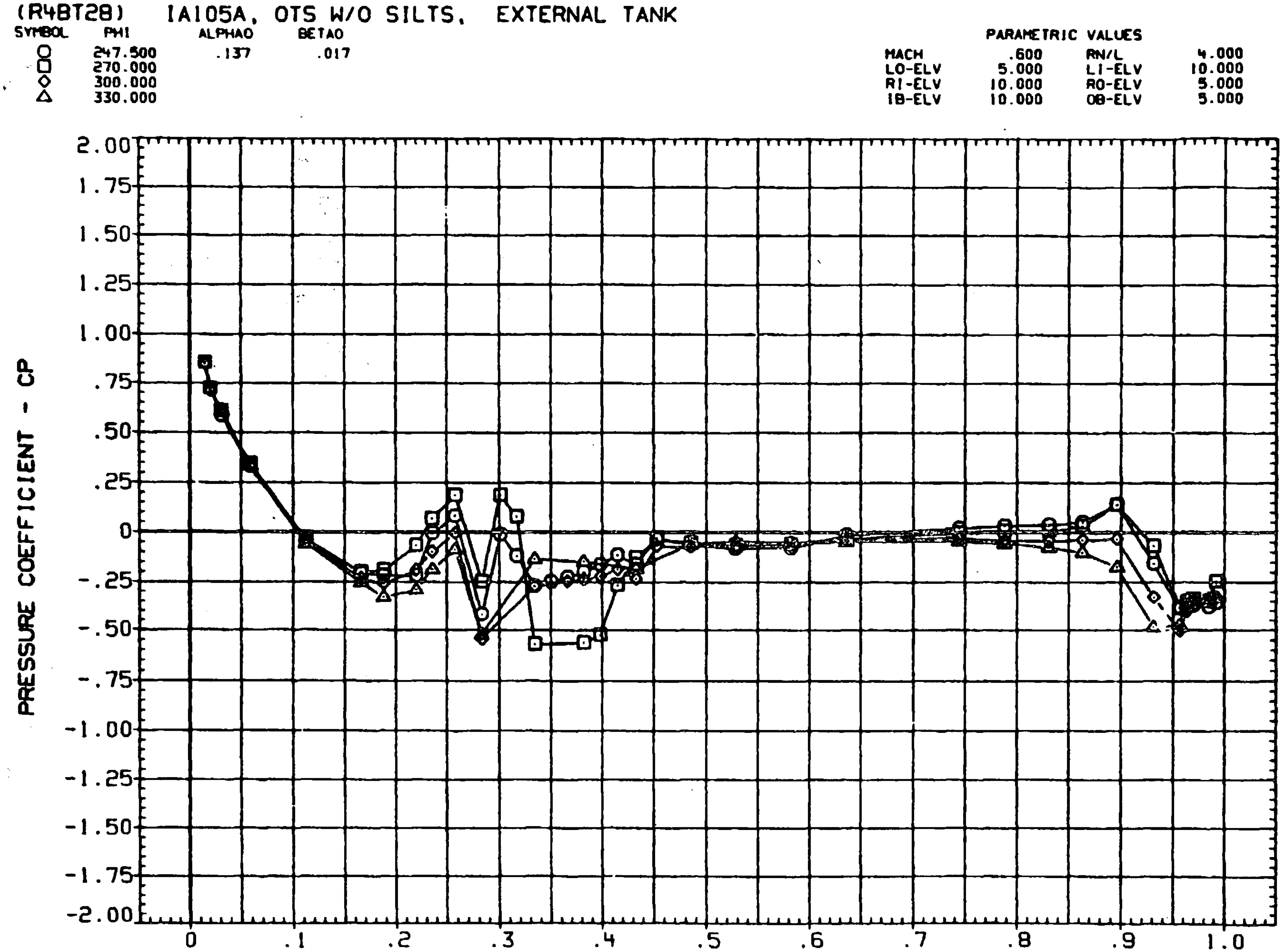

FIGURE 10. TYPICAL PRESSURE DISTRIBUTION - ET SURFACE

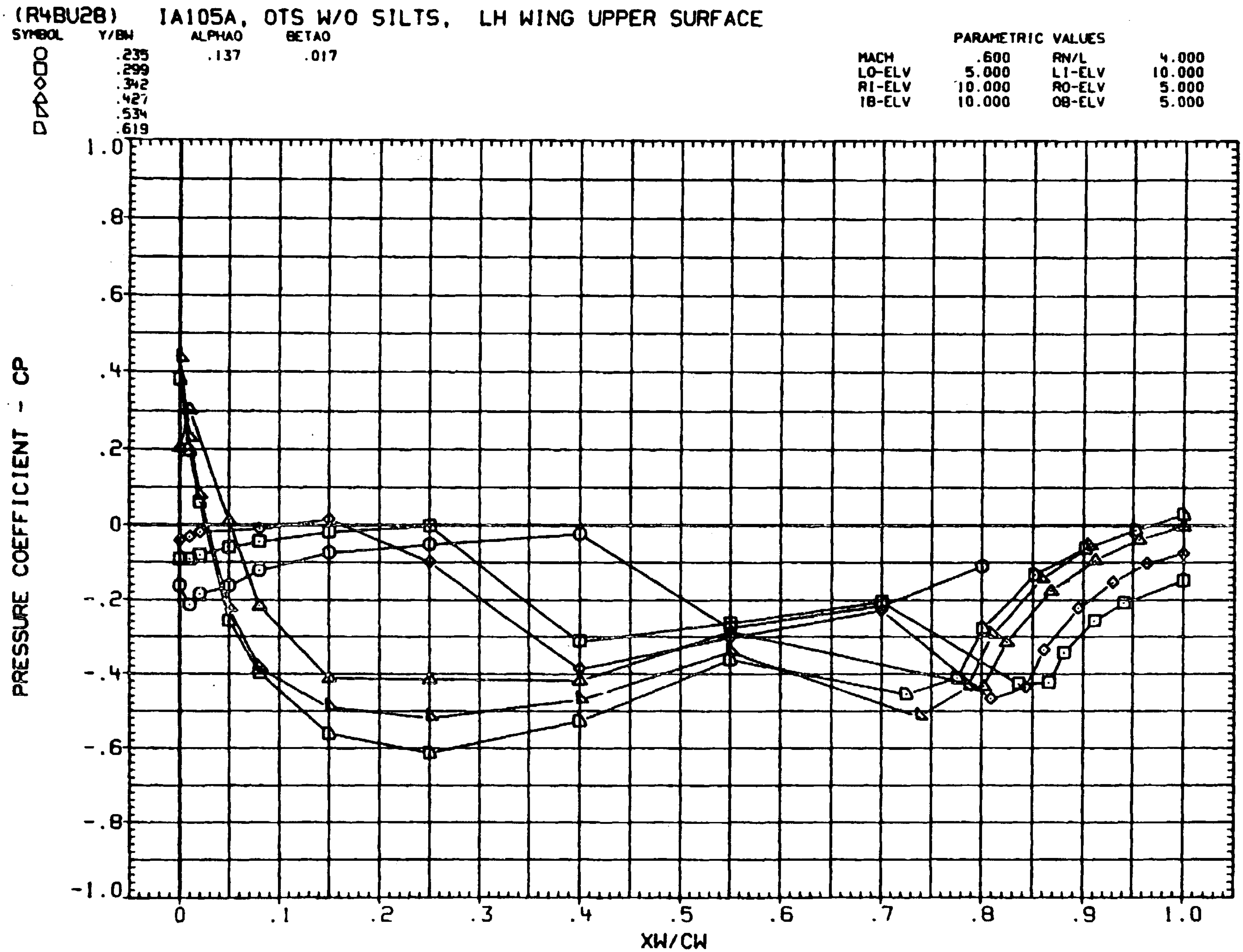

FIGURE 11. TYPICAL PRESSURE DISTRIBUTION - WING - UPPER SURFACE

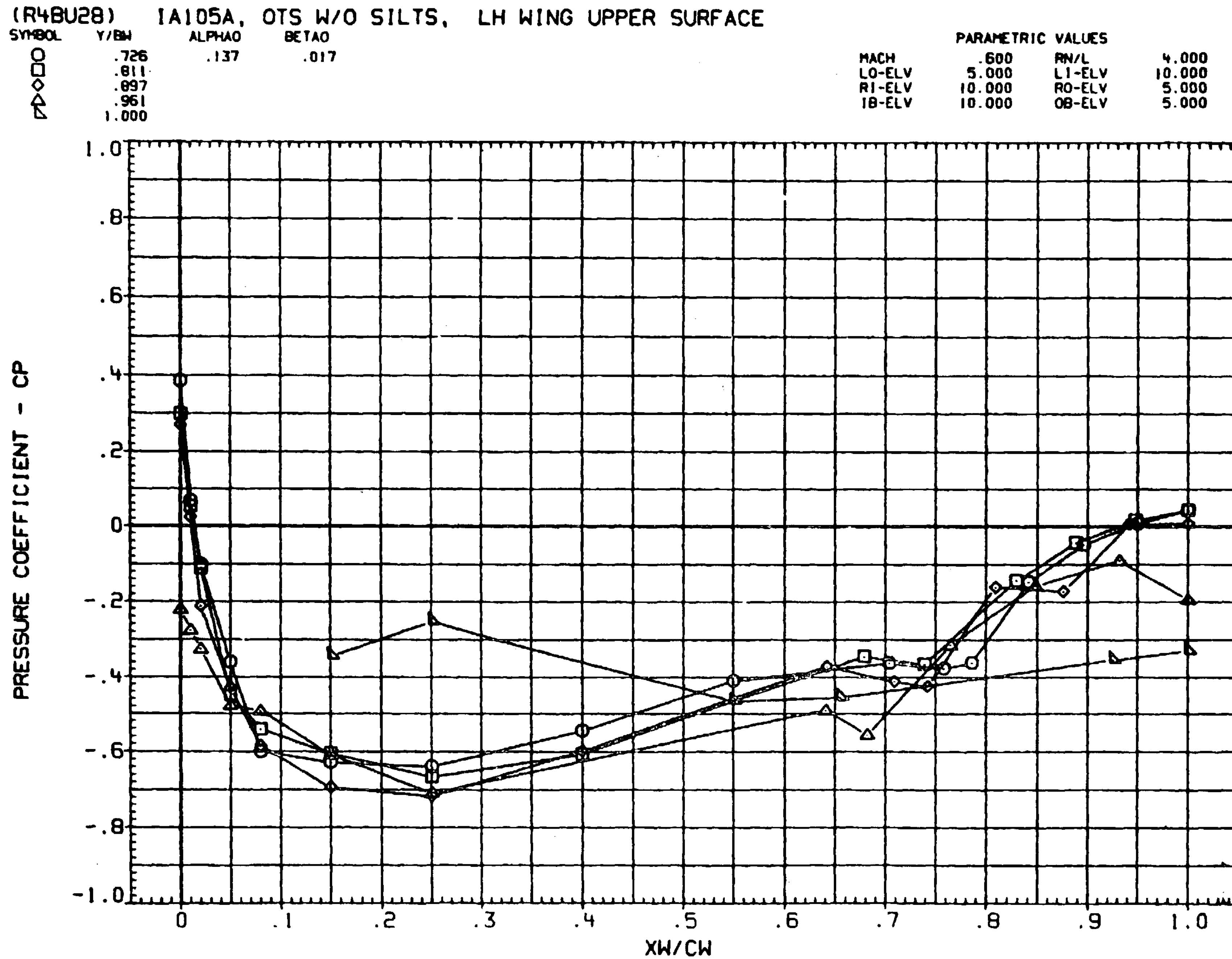

FIGURE 11. TYPICAL PRESSURE DISTRIBUTION - WING - UPPER SURFACE

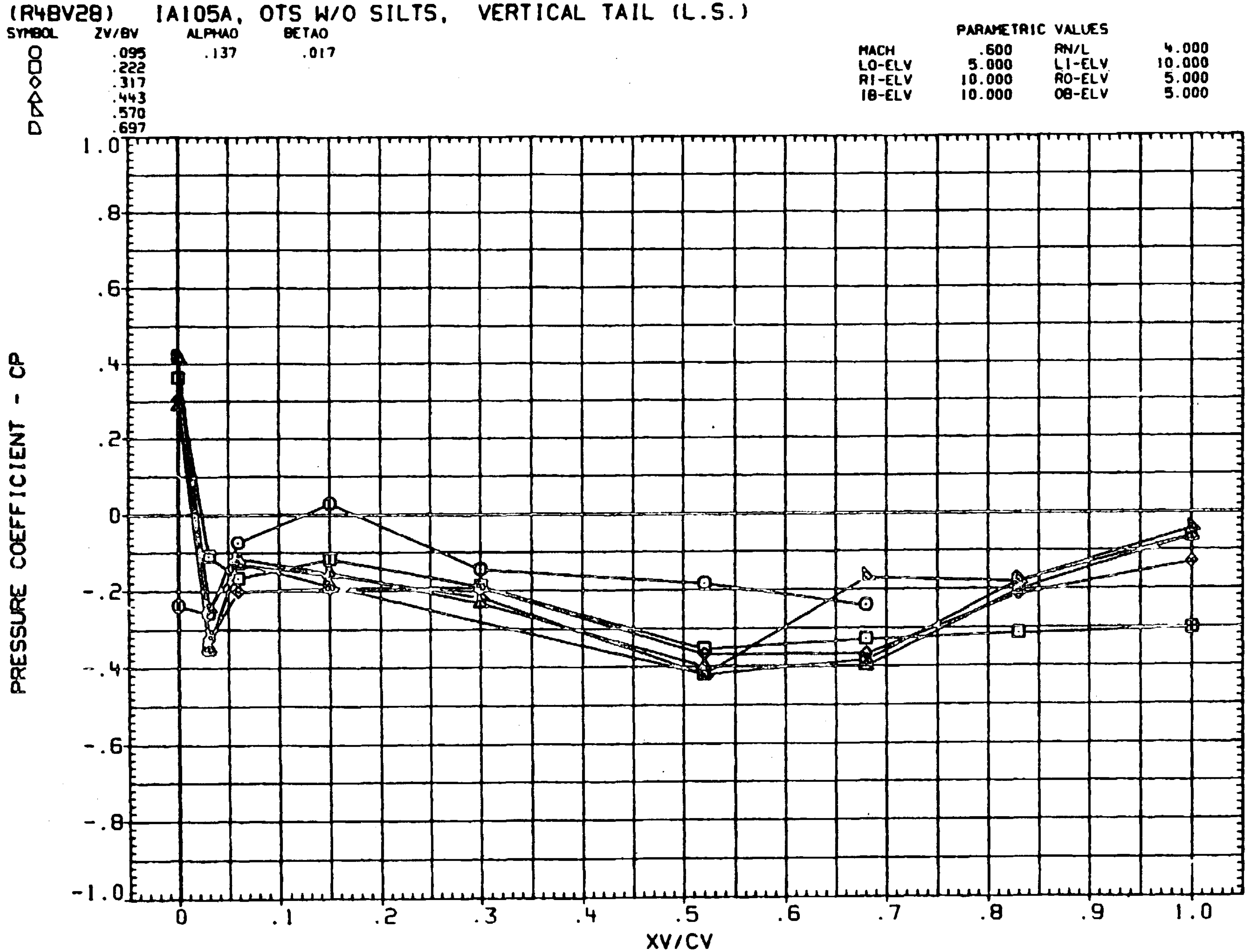

FIGURE 12. TYPICAL PRESSURE DISTRIBUTION - VERTICAL TAIL

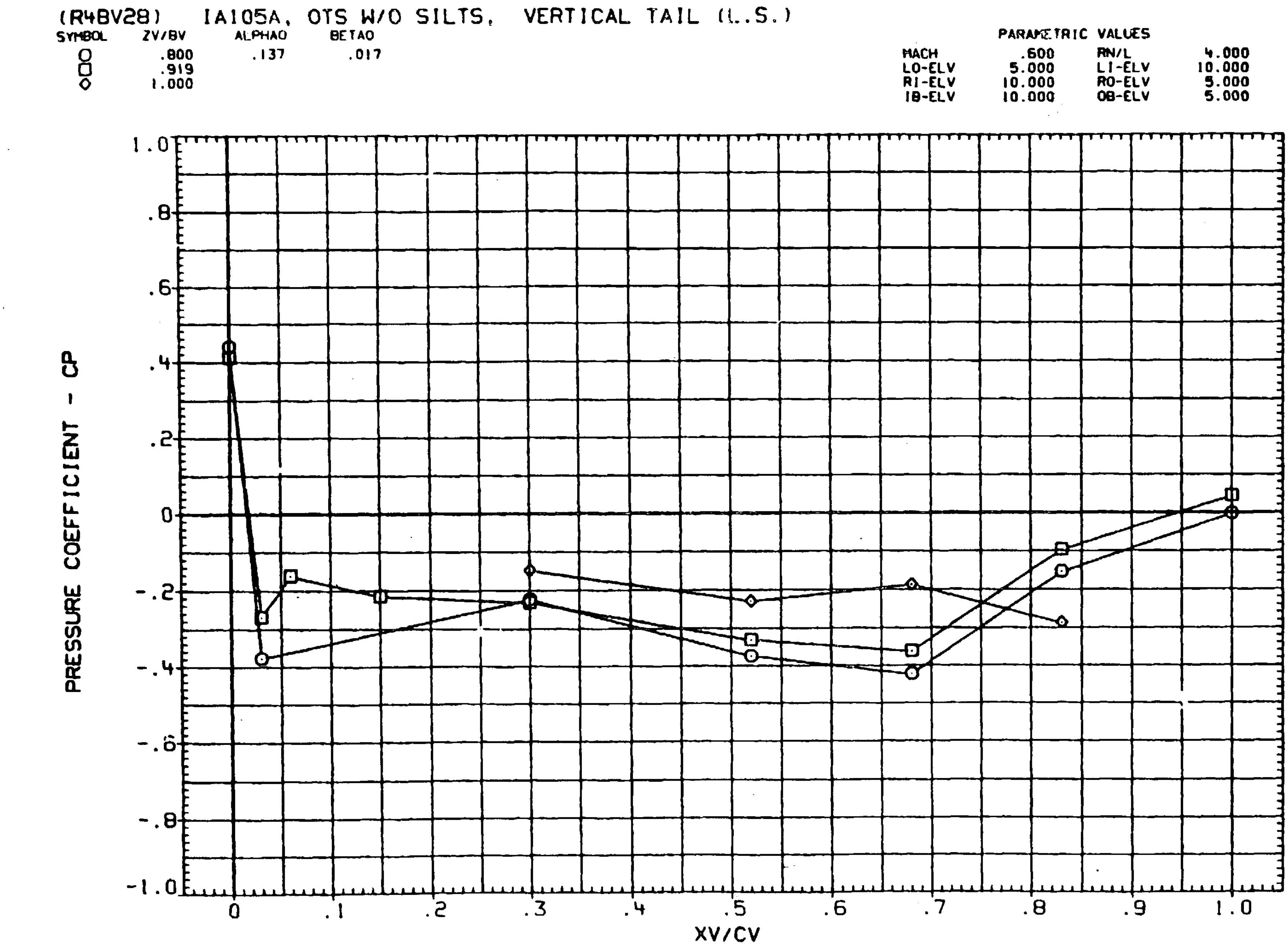

FIGURE 12. TYPICAL PRESSURE DISTRIBUTION - VERTICAL TAIL

APPENDIX

TABULATED PRESSURE SOURCE DATA

(MICROFICHE ONLY)